

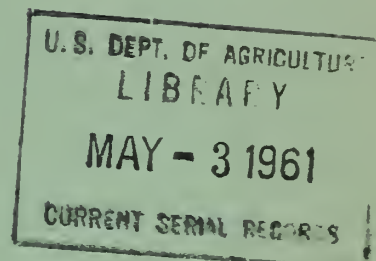
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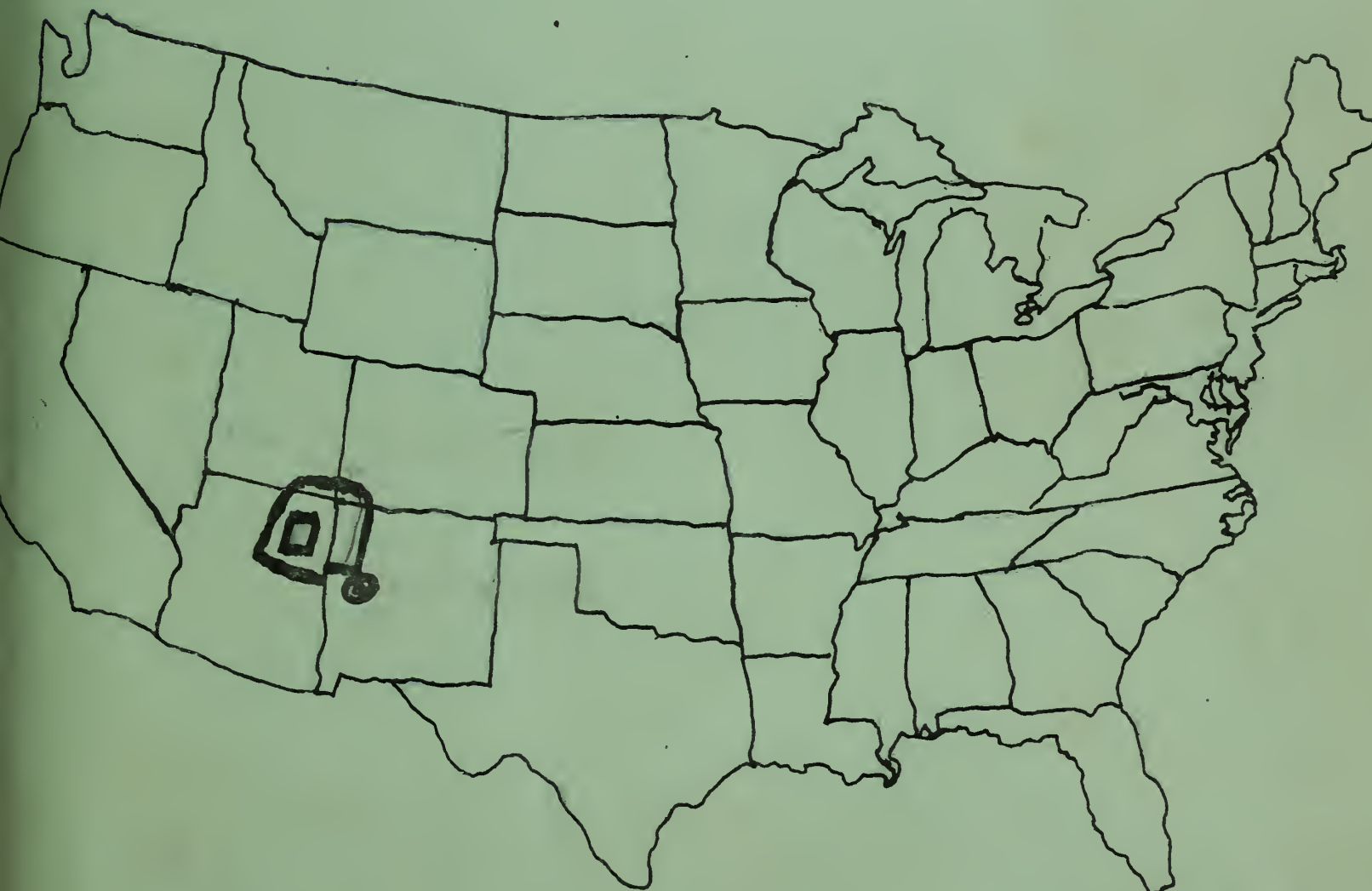
UNITED STATES DEPARTMENT OF AGRICULTURE
AGRICULTURAL RESEARCH ADMINISTRATION

BUREAU OF ANIMAL INDUSTRY
COOPERATING WITH
UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS



TWELFTH ANNUAL REPORT OF THE
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

OCTOBER 31, 1948



THIS REPORT OF RESEARCH PROJECTS NOT YET COMPLETED IS INTENDED FOR THE
USE OF ADMINISTRATIVE LEADERS AND WORKERS IN THIS OR RELATED FIELDS OF
RESEARCH, AND NOT FOR GENERAL DISTRIBUTION.

ANNUAL REPORT OF CONDITIONS AND ACTIVITIES
SOUTHWESTERN RANGE AND SHEEP BREEDING LABORATORY
FORT WINGATE, NEW MEXICO

November 1, 1947, to October 31, 1948

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ROSTER OF PERSONNEL

<u>Name</u>	<u>Title</u>	<u>Date entered on duty</u>	<u>Duties</u>
James O. Grandstaff	Animal Husbandman	Jan. 13, 1944	Director
John V. Christensen	Animal Fiber Tech.	Feb. 3, 1947	Wool Tech.
George M. Sidwell*	Animal Husbandman	Dec. 1, 1946	Genetics
Johnnie P. Sinclair	Animal Husbandman	Oct. 19, 1948	Sheep and Wool Research Ass't. .
Orval LeRoy Navarre	Stockman	Feb. 6, 1947	Sheep Management
Albert G. Dumont**	Scientific Aid	Feb. 24, 1947	Lab. Assistant
Araminta D. Costello	Clerk-Stenographer	July 1, 1947	Clerical
Jerome H. Singer***	Statistical Clerk	Jan. 29, 1948	Sheep Records
Jimmie Gleason	Janitor	Apr. 1, 1942	Janitor and Maintenance
Marion Chadacloi	Agricultural Aid	Jan. 12, 1944	Miscellaneous
Alfred Dempsey	Laboratory Aid	Dec. 23, 1947	Miscellaneous
Fred Deschene	Agricultural Aid	Oct. 2, 1947	Miscellaneous

*On leave without pay September 1947 to August 1948 for postgraduate study at Iowa State College, Ames, Iowa.

**Resigned August 20, 1948.

***Resigned May 28, 1948.

OBJECTIVE

The main objective of this laboratory is the development of types of sheep which are adapted to the range conditions of the southwest, and to the economic requirements of Navajo Indians and other sheepmen of this area. In the pursuit of this objective, basic breeding methods are employed, utility values of the wool with respect to hand weaving are studied, and the selection of breeding animals is based upon production as measured under range environment. Emphasis is placed primarily on adaptability and longevity of the sheep, yield of wool and its suitability with respect to hand weaving and commercial manufacture, and the quantity and quality of lambs produced.

OUTLINE OF RESEARCH PROGRAM

Under Special Research Project SRF-2-2 entitled "The development of breeds and strains of sheep suitable to southwestern ranges and to the economic requirements of the sheepmen", there are five active research line projects, and three that were discontinued during the year covered by this report.

Active Research Line Projects:

- SRF-2-2-(2) Improvement of Navajo sheep by linebreeding and selection in the Navajo strain.
- SRF-2-2-(5) Improvement of Navajo sheep by crossbreeding and selection for the production of wool suitable for both hand and commercial methods of manufacture.
- SRF-2-2-(6) Improvement of Navajo sheep by crossbreeding and selection for range production of wool and lambs.
- SRF-2-2-(7) Development of an efficient method of selecting animals used in the program of the Southwestern Range and Sheep Breeding Laboratory.
- SRF-2-2-(8) Studies of the adaptability to southwestern ranges of crossbred strains of sheep having different proportions of Navajo and improved blood.

Discontinued Research Line Projects:

- SRF-2-2-(1) Improvement of the wool of Navajo sheep by studying the physical and chemical properties of Navajo wool as found in old Navajo blankets, and in the fleeces of Navajo sheep.

The basic phases of the work authorized by SRF-2-2-(1) have been completed. The work that is now intended for research, that was previously authorized by SRF-2-2-(1), is included in SRF-2-2-(2).

Summary of accomplishments of project SRF-2-2-(1): Methods have been developed for evaluating the fiber characteristics of the fleeces of Navajo sheep, and the characteristics of Navajo wool have been studied in relation to the suitability of the wool for hand weaving by Navajo Indians. Results of these studies are presented in the following publications:

1. A Rapid Method for Projecting and Measuring Cross-sections of Wool Fibers; James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.
2. Wool Characteristics in Relation to Navajo Weaving; James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.
3. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint; James O. Grandstaff, Rayon Textile Monthly, October-November 1941.
4. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep; James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.
5. Evaluating Fleece Quality of Navajo Sheep from Small Samples; James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.
6. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs; James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947.

SRF-2-2-(3) Improvement of sheep for Navajo Indians through crossbreeding of old-type Navajo sheep with improved breeds such as Romney and Corriedale, followed by selective line-breeding matings of the F_1 (and succeeding generations) crossbred animals inter se.

The work authorized by SRF-2-2-(3) did not produce results which conformed to the objectives of this line project, particularly with reference to the grade of wool produced, the fleeces of a high proportion of the crossbred sheep being from one to three grades finer than the desired $1/4$ Blood type of wool. The work that is now authorized for research is outlined in the new research line project SRF-2-2-(5).

Summary of accomplishments of project SRF-2-2-(3): Results obtained by crossbreeding old-type Navajo ewes as authorized by SRF-2-2-(3) are covered by the following publications:

1. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs;
Cecil T. Blunn, Journal of Animal Science, August 1945.
2. Comparison of Corriedale x Navajo and Romney x Navajo Crosses;
James O. Grandstaff, Journal of Animal Science, November 1948.

Additional data collected in the conduct of SRF-2-2-(3) has not yet been prepared for publication.

SRF-2-2-(4) Improvement of wool of crossbred sheep to meet the requirements of Navajo Indians by studying the physical and chemical properties of crossbred wools.

The work that is now authorized for research, that was previously covered by SRF-2-2-(4) is included in the new research line project SRF-2-2-(5).

Summary of accomplishments of project SRF-2-2-(4); Results of work performed under SRF-2-2-(4) are presented in the following publications:

1. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep;
Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science,
May 1944.
2. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs;
James O. Grandstaff and Harold W. Wolf, Journal of Animal Science,
May 1947.
3. Comparison of Corriedale x Navajo and Romney x Navajo Crosses;
James O. Grandstaff, Journal of Animal Science, November 1948.

Research and Marketing Act Projects:

Work authorized by the following Research and Marketing Act projects of the Bureau of Animal Industry was conducted at this laboratory in addition to other locations including Dubois, Idaho, and Beltsville, Maryland.

Project RM-b-204 (BAI) entitled "Relation of genetic factors to the market value of wool": This project ceased to be in effect on June 30, 1948.

Project RM-a-427 I Subtitle (BAI) entitled "Evaluation of wool from sheep, goats, and rabbits with respect to fabrication, felting, and insulating properties affected by genetic variation", was commenced July 1, 1948.

PUBLICATIONS

The following papers have been published since the establishment of the Southwestern Range and Sheep Breeding Laboratory:

1. The Navajo Sheep Industry and Needs for Its Improvement;
J. M. Cooper, The Sheep Breeder, May 1939.
2. The Sheep Industry of Indians in the Southwest;
J. M. Cooper and Dewey Dismuke, Indians At Work, August 1939.
3. Breeding for Adaptability to Local Conditions, with Special Reference
to Sheep on the Navajo Indian Reservation;
J. M. Cooper, American Society of Animal Production, 1939.
4. Improvement of the Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, March 1940.
5. Breeding for Quality Wool;
James O. Grandstaff, The National Wool Grower, July 1940.
6. A Rapid Method for Projecting and Measuring Cross Sections of Wool Fibers;
James O. Grandstaff and Walter L. Hodde, Circular No. 590, U. S. Department of Agriculture, December 1940.
7. Evaluating Fleece Characteristics of Navajo Sheep from a Breeding Standpoint;
James O. Grandstaff, Rayon Textile Monthly, October-November 1941.
8. Wool Characteristics in Relation to Navajo Weaving;
James O. Grandstaff, Technical Bulletin No. 790, U. S. Department of Agriculture, January 1942.
9. Characteristics and Production of Old-Type Navajo Sheep;
Cecil T. Blunn, Journal of Heredity, May 1943.
10. The Influence of Seasonal Differences on the Growth of Navajo Lambs;
Cecil T. Blunn, Journal of Animal Science, February 1944.
11. A Preliminary Report on the Post-natal Development of the Fiber Characteristics of the Fleeces of Navajo Sheep;
James O. Grandstaff and Cecil T. Blunn, Journal of Animal Science, May 1944.

12. Comparison of the Yields of Side Samples from Weanling and Yearling Sheep; Cecil T. Blunn and James O. Grandstaff, Journal of Animal Science, May 1944.
13. Yearly Differences in Growth of Navajo and Crossbred Ewe Lambs; Cecil T. Blunn, Journal of Animal Science, August 1945.
14. Evaluating Fleece Quality of Navajo Sheep from Small Samples; James O. Grandstaff and Cecil T. Blunn, Journal of Agricultural Research, September 1945.
15. Improvement of Wool for Navajo Hand Weaving; James O. Grandstaff and Cecil T. Blunn, Indians At Work, March 1945.
16. Relation of Kemp and Other Medullated Fibers to Age in the Fleeces of Navajo and Crossbred Lambs; James O. Grandstaff and Harold W. Wolf, Journal of Animal Science, May 1947.
17. Comparison of Corriedale x Navajo and Romney x Navajo Crosses; James O. Grandstaff, Journal of Animal Science, November 1948.
18. Size of Lambs at Weaning as a Permanent Characteristic of Navajo Ewes; George M. Sidwell and James O. Grandstaff, accepted for publication in the Journal of Animal Science.

SOME OF THE IMPORTANT ACCOMPLISHMENTS OF THE
LABORATORY DURING ITS FIRST 12 YEARS, 1936-1948

1. It has been demonstrated that the old-type Navajo sheep possess certain traits which have an important bearing on economic returns from wool and lamb production under southwestern range conditions. These traits are as follows: adaptability to the environment, a high level of fertility, reproduction and longevity, also good milk production and a well developed maternal instinct in lactating ewes.
2. A method has been developed for quickly evaluating fleece quality of Navajo sheep from small samples.
3. The influence of various physical properties of Navajo wool on its suitability for Navajo hand weaving have been determined.
4. The physical characteristics of the various grades of commercial wools have been studied in relation to their suitability for Navajo hand weaving, and the type of wool suitable for hand weaving and with good market value has been determined.

5. Basic information on reproduction of Navajo sheep for use in studies of breeding and selection have been collected.
6. Information on important economic traits of Navajo sheep have been collected for use in determining heritability estimates and development of selection indexes.
7. Heritability estimates for objectionable kemp and other medullated fibers found in the fleeces of Navajo sheep have been calculated.
8. An estimate of the repeatability of weaning weights of lambs from Navajo ewes has been calculated.
9. The effects of certain major environmental factors on weaning weights of Navajo lambs have been determined.
10. Average grease fleece weight of Navajo ewes at yearling age has been increased from 3.8 pounds to about 6.3 pounds through selection and breeding, and improved management.
11. Fleece quality of Navajo sheep has been greatly improved by reduction in the amounts of coarse outercoat, kemp and other medullated fibers in their fleeces. This represents a permanent genetic gain accomplished through breeding and selection.
12. The possibility of developing a pure strain of Navajo sheep with non-hairy fleece has been demonstrated and progress toward this objective is being made.
13. The basic procedures for development of a new breed of sheep for the production of wool suitable for both hand and commercial methods of manufacture, and with adaptability to southwestern range conditions, have been worked out.
14. The performance of two, three, and four breed crosses, representing matings of old-type Navajo ewes with purebred rams of the Corriedale, Romney; and Columbia breeds, inter se matings of (Corriedale x Navajo) and (Romney x Navajo) ewes and rams; and matings of the latter type ewes with purebred Cotswold and Lincoln rams have been studied. Data on important economic traits of the progeny of these various crosses have been collected for use in heritability studies and the development of selection indexes.
15. Through crossbreeding of old-type Navajo ewes with purebred rams, followed by selection and inter-breeding of the progeny, average grease fleece weights of ewes and rams at yearling age have been increased about a hundred percent and fleece quality has been greatly improved, in comparison with the fleeces of the foundation old-type Navajo ewes. A major portion of the wool produced by the improved sheep is of the desired 1/4 Blood and Low 1/4 Blood grades.

16. Crossbreeding of Navajo sheep has resulted in marked improvement in body type and conformation of the offspring at market age and maturity, without appreciable loss in fertility of breeding animals or liveability of lambs.
17. It has been demonstrated that many important traits of pure strain Navajo and crossbred Navajo sheep can be evaluated at weaning age.

SUMMARY OF PRECIPITATION

Year	Precipitation in Inches												Total
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	
1864-1911	0.96	1.42	1.02	0.98	0.58	0.69	2.34	2.31	1.37	1.05	0.76	0.97	14.45
1938	0.52	0.79	1.95	0.43	0.61	1.67	0.78	1.84	0.85	0.10	0.67	0.24	10.47
1939	1.96	0.62	0.64	1.57	0.29	Tr.	0.85	1.23	1.31	0.30	0.10	1.22	10.09
1940	0.76	0.53	0.59	0.53	0.61	1.00	0.48	1.92	2.05	2.15	0.89	2.14	13.65
1941	0.89	1.12	1.80	1.46	2.10	0.76	0.71	1.75	4.05	2.40	0.73	0.70	18.47
1942	0.33	1.04	0.75	0.96	0.00	0.00	0.64	1.87	1.31	1.71	0.15	1.17	9.93
1943	1.48	0.24	1.61	0.46	0.28	0.41	2.30	1.94	0.30	1.65	Tr.	0.88	11.55
1944	0.64	0.71	1.07	0.21	0.87	0.14	1.10	1.91	0.99	1.49	0.93	1.42	11.48
1945	0.72	0.25	0.96	0.44	0.05	0.21	2.70	3.63	0.05	1.78	0.00	2.03	12.82
1946	0.49	0.07	0.25	0.72	Tr.	0.05	2.22	4.89	1.98	0.65	1.51	0.46	13.29
1947	0.48	0.10	0.12	Tr.	2.08	0.41	1.31	4.32	0.76	1.22	1.17	0.57	12.64
1948	0.24	1.19	1.15	0.13	0.58	1.09	2.38	2.23	1.14	0.69	0.17	1.64	12.63

The preceeding table summarizes the precipitation at Fort Wingate, New Mexico, for the 47-year period (1864-1911) and for individual years from 1938 to 1948 inclusive. In 1948 the total precipitation of 12.63 inches was slightly above the average of the preceeding 10 years, and was distributed in almost the same proportion, with about one third during the first six months and two thirds during the last six months of the year. Total precipitation in 1948, however, was 12.5 percent below the 47 year (1864-1911) average.

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OUTLINE OF BREEDING PROGRAM

<u>Number of Breeding Group</u>	<u>Breeding of Rams</u>	<u>Breeding of Ewes</u>
1	N x	N
2	R ₁ x	N
3	K x	N
4*	(C ₁ x N) x (R ₁ x N) x	(R ₁ x N) x (C ₁ x N)
5*	(R ₁ x N) x (C ₁ x N) x	(C ₁ x N) x (R ₁ x N)
6	L x	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)
7	C ₂ x	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)
8	C ₂ x (C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N) x	K x N
9	K x N x	C ₂ x (C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)

Code of Symbols for Breeds

N - Navajo
R₁ - Romney

C₁ - Corriedale
K - Columbia

C₂ - Cotswold
L - Lincoln

*Breeding groups 4 and 5 were discontinued after the 1946-47 breeding season, and ewes of groups 4 and 5 were assigned to groups 6 and 7 in the breeding season of 1947-48. However, this report includes data on yearling ewes and rams that are the product of matings indicated for groups 4 and 5, in the breeding season of 1946-47.

SUMMARY OF BREEDING PENS

Breeding Group	Pen No.	Ram No.	<u>Breeding of Rams</u>	<u>Breeding of Ewes</u>	No. of Ewes
1	1	2I	N	N	35
1	2	15J	N	N	26
1	3	83E	N	N	35
1	4	19H	N	N	24
2	W12	17-45	R ₁	N	30
2	W13	71-45	R ₁	N	30
2	W14	19-46	R ₁	N	30
2	W15	83-46	R ₁	N	30
3	W7	5228K	K	N	27
3	W8	4306K	K	N	25
3	W9	5079K	K	N	26
3	W10	5952K	K	N	25
3	W11	5526K	K	N	24
6	W1	468	L	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	83
6	W2	87-46	L	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	79
6	W3	108-46	L	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	81
6	W4	51-46	L	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	78
7	W5	1343	C ₂	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	76
7	W6	1381	C ₂	(C ₁ x N) x (R ₁ x N) (R ₁ x N) x (C ₁ x N)	78

Breeding Group	Pen No.	Ram No.	Breeding of Rams	Breeding of Ewes	No. of Ewes
8	W16	W211I	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R_1 & \times & N \end{pmatrix} \times \begin{pmatrix} R_1 & \times & N \\ C_1 & \times & N \end{pmatrix}$	K x N	35
8	W17	W75I	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R_1 & \times & N \end{pmatrix} \times \begin{pmatrix} R_1 & \times & N \\ C_1 & \times & N \end{pmatrix}$	K x N	35
9	W18	W126I	K x N	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R_1 & \times & N \end{pmatrix} \times \begin{pmatrix} R_1 & \times & N \\ C_1 & \times & N \end{pmatrix}$	28
9	W19	W601I	K x N	$C_2 \times \begin{pmatrix} C_1 & \times & N \\ R_1 & \times & N \end{pmatrix} \times \begin{pmatrix} R_1 & \times & N \\ C_1 & \times & N \end{pmatrix}$	28

SUMMARY OF BREEDING PROGRAM

The breeding program for 1947-48 is summarized in the preceeding table. Each type of mating is designated by a breeding group number. In order to eliminate repetition and confusion, each breeding group will be referred to throughout this report by the group numbers given in the preceeding summary.

The breeding flock in 1947 was made up of 968 ewes. This represents an increase of 7.2 percent over the number of ewes bred in 1946. There were 367 Navajo ewes of which 120 were mated to Navajo rams, 120 to Romney rams, and 127 to Columbia rams. All ewes were pen bred for 30 days from December 6 to January 8.

In group 6, Lincoln rams were mated to 321 ewes that were originally produced in groups 4 and 5. In group 7, Cotswold rams were mated to 154 ewes that were produced in groups 4 and 5. In group 8, the rams are the product of matings similar to those represented in group 7, and the ewes are the product of matings listed for group 3. In group 9, the matings were the reciprocal of matings outlined for group 8.

PROGENY TESTING OF CROSSBRED RAM LAMBS

Five crossbred ram lambs were mated to 98 ewes. The ram lambs used for breeding in 1947-48 included two that were produced in group 2, one ram that was produced in group 3, and two rams produced in group 7. The ewes in these test pens were of unknown parentage, predominately of crossbred breeding.

Breeding performance of the ram lambs was measured by the number, quality and weight of their progeny at weaning age. Rams which gave satisfactory breeding performance as lambs, will be assigned to one of the regular breeding groups at yearling age. Since the number of ewes available for progeny

testing ram lambs is so limited, possibly they could be used more effectively for testing only Navajo ram lambs. If this procedure were adopted, the small number of Navajo ewes available for mating with Navajo rams could be mated to tested yearling rams each year; thus, the generation length would be shortened and the genetic improvement within the Navajo flock increased over what it has been in the past.

CHARACTERISTICS OF BREEDING RAMS

In the selection of breeding rams major emphasis has been placed on fleece quality. Fleece characteristics considered are grade, staple length, uniformity, freedom from kemp and other medullated fibers, and yield of clean wool.

The following table summarizes the important fiber characteristics and wool production of the rams used in the 1947-48 breeding program. Just prior to shearing the rams, a coin envelope sample and a can sample of wool were removed from the middle of the left side of each sheep for laboratory determination of various physical properties of the fleeces. The coin envelope sample was used for the determination of average fiber diameter, uniformity, staple length, and percentages of kemp and other medullated fibers. The rapid count method was used for the determination of fiber diameter and frequency of kemp and other medullated fibers. Can samples were scoured for yield determinations. At shearing time all fleeces were weighed to the nearest 0.05 pound. Clean fleece weight was calculated by multiplying the grease fleece weight by the percent yield, of the can sample.

While the Navajo rams used in 1947-48 were not superior in wool production to Navajo rams used in recent years, they did exhibit a marked improvement in fleece quality. All rams had improved, non-hairy fleeces with no kemp or other medullated fibers present. The average grade was the desired 48's.

Several purebred rams of the Romney, Columbia, Lincoln, and Cotswold breeds were used for breeding. All of these rams were good specimens of their respective breeds, with respect to body type and fleece weights. The Cotswold rams, selected from a very limited number of available purebred rams, produced fleeces containing fairly high percentages of medullated fibers, other than kemp.

The Cotswold F₁ rams mated to the ewes of group 8, and the Columbia F₁ rams mated to the ewes of group 9, were the outstanding individuals in size, type, and fleece production and quality of the available yearling rams. The average grade was the desired 48's or coarser. No kemp fibers were present in the samples from any of the rams, and only one ram possessed any medullated fibers, other than kemp. All of the fleeces had a desirable crossbred character.

CHARACTERISTICS OF BREEDING RAMS

Pen No.	Ram No.	Age of ram at breeding (years)	Fleece weight as yearling		Fineness at side Diameter : Grade (microns)	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
			Grease : Clean (lbs.)	(lbs.)				
NAVAJO RAMS:								
1	2I	1	7.63	4.60	33.0	48's	16.7	0.0
2	15J	Lamb	9.00	4.54	35.1	46's	21.0	0.0
3	19H	2	5.40	3.49	31.4	50's	17.3	0.0
4	83E	5	8.20	5.03	29.2	50's	18.5	0.0
Average			7.56	4.42	32.2	48's	18.4	0.0
ROMNEY RAMS:								
WL2	17	2	12.30	8.27	39.0	36's	18.9	1.0
WL3	71	2	11.80	7.54	35.8	44's	18.8	0.0
WL4	19	1	10.42	5.95	35.7	44's	15.4	0.0
WL5	83	1	10.61	5.21	33.4	48's	12.3	0.0
Average			11.28	6.74	35.9	44's	16.4	0.2
COLUMBIA RAMS:								
W7	5228K	2	11.15	5.20	30.5	50's	11.8	0.0
W8	4306K	4	15.75	8.03	29.0	56's	11.9	0.0
W9	5079K	2	9.99	5.33	32.2	48's	10.0	0.0
W10	5952K	1	13.20	7.00	31.5	50's	15.0	0.0
W11	5526K	2	11.00	6.09	32.6	48's	13.1	0.0
Average			12.22	6.33	31.2	50's	12.4	0.0

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16
17	18	19	20
21	22	23	24
25	26	27	28
29	30	31	32
33	34	35	36
37	38	39	40
41	42	43	44
45	46	47	48
49	50	51	52
53	54	55	56
57	58	59	60
61	62	63	64
65	66	67	68
69	70	71	72
73	74	75	76
77	78	79	80
81	82	83	84
85	86	87	88
89	90	91	92
93	94	95	96
97	98	99	100

CHARACTERISTICS OF BREEDING RAMS (con't.)

Pen No.	Ram No.	Age of ram at breeding (years)	Fleece weight as yearling		Fineness at side		Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
			Grease : Clean (lbs.)	(lbs.)	Diameter : Grade (microns)	Grade			
<u>LINCOLN RAMS:</u>									
W1	468	2	16.80	10.85	38.0	40's	23.4	0.0	0.0
W2	87	1	16.01	9.87	39.8	36's	22.4	0.0	0.0
W3	108	1	12.92	8.12	34.3	46's	20.0	0.0	0.0
W4	51	1	13.31	7.82	35.0	46's	23.9	0.0	8.3
Average			14.76	9.16	36.8	44's	22.4	0.0	2.1
<u>COTSWOLD RAMS:</u>									
W5	1343	3	17.25	10.16	34.6	46's	39.5	0.0	30.9
W6	1381	2	17.60	10.44	39.2	36's	32.5	0.0	10.2
Average			17.42	10.30	36.9	44's	36.0	0.0	20.6
<u>COTSWOLD F₁ RAMS:</u>									
W16	W211I	1	11.57	7.54	33.8	46's	23.0	0.0	2.3
W17	W75I	1	9.93	5.32	35.0	46's	20.6	0.0	0.0
Average			10.75	6.43	34.4	46's	21.8	0.0	1.2
<u>COLUMBIA F₁ RAMS:</u>									
W18	W126I	1	11.46	5.50	30.2	50's	15.2	0.0	0.0
W19	W601I	1	10.95	4.52	34.2	46's	16.5	0.0	0.0
Average			11.20	5.01	32.2	48's	15.8	0.0	0.0

The fleece data for Romney, Lincoln, and Cotswold rams were taken on their fleeces sheared at two years of age. These rams were purchased after their yearling fleeces had been sheared.

CHARACTERISTICS OF BREEDING EWES

Various characteristics of the breeding ewes are summarized in the following table, by breeding groups and pens. The data on fleece production and fiber qualities are for the yearling fleeces. Sampling and analytical procedures were the same as described under characteristics of the breeding rams.

Straight-bred Navajo ewes are represented in groups 1, 2, and 3. Groups 2 and 3, bred to Romney and Columbia rams respectively, are younger by 4.2 and 3.4 years than the Navajo ewes of group 1. Other than age the principle difference in these three groups is found in fleece weights, both grease and clean, and the average grade of the fleeces produced. Excessive shedding of wool prior to shearing in 1945, 1946, and 1947 is responsible for the lighter fleece weights of the younger ewes. While no definite cause for the wool shedding can be advanced, it is thought to be associated with nutritional conditions encountered during the winter months. With an average grade of '56's, the Navajo ewes of groups 2 and 3 were a grade coarser than the ewes of group 1. Also, among the younger ewes in groups 2 and 3 there were more that produced improved non-hairy or slightly hairy fleeces, than there were in group 1.

The ewes of groups 6 and 7 were quite similar in all characteristics. These ewes, having inheritance of one half Navajo one fourth Romney, and one fourth Corriedale were mated to Lincoln and Cotswold rams, to effect a correction in fleece grade and staple length.

The ewes of group 8 are the result of the matings indicated in the breeding program for group 3. Ewes of group 9 are the result of the matings indicated for group 7. In groups 8 and 9, the ewes showed a distinct improvement over their dams, in body weight and in fleece production and quality. Generally, the ewes of groups 8 and 9 produced attractive crossbred type fleeces, grading 1/4 Blood or coarser, and with satisfactory staple length and character.

The ewe flock was culled during the latter part of October. At this time, the mouth and udder of each ewe was inspected for unsoundness. From a total of 426 Navajo ewes on hand, 49 head, or 11.50 percent, were culled. Of this number, 43 were culled for age, four for unsound udders, and two yearling ewes were culled because of undesirable fleeces.

The number of crossbred ewes culled was 103, representing 12.48 percent of the total number of crossbred ewes on hand. Of the 103 ewes culled, one had an excessive amount of color on face and legs, five had unsound udders, 22 were culled for low fleece quality due to hair or kemp, and 75 were culled for age. Fifteen of the ewes culled on fleece quality were of yearling age.

No selection was practiced for lamb production, among either the Navajo ewes or crossbred ewes, as all lamb production records had not yet been posted on the individual ewe cards at the time the ewes were culled. This work was delayed as a result of vacancies in one or more positions during the major part of the year.

CHARACTERISTICS OF BREEDING EWES

Pen No.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling (lbs.)	Grease: Clean (lbs.)	Fineness at side Diameter: (microns)	Grade	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)
<u>GROUP NO. 1:</u>										
1	35	7.5	99.5	5.58	3.33	26.0	58's	9.0	0.3	0.6
2	26	8.3	98.6	5.28	2.99	25.9	58's	8.7	1.2	0.9
3	35	7.5	99.4	4.94	3.19	25.5	60's	9.2	0.7	0.3
4	24	6.1	100.0	5.66	3.45	25.2	60's	9.3	0.3	0.6
Total and Averages	120	7.4	99.4	5.34	3.24	25.7	58's	9.0	0.6	0.6
<u>GROUP NO. 2:</u>										
W12	30	3.2	97.6	4.03	2.50	28.3	56's	9.8	0.2	2.7
W13	30	3.2	97.8	3.94	2.49	28.4	56's	9.9	0.2	3.0
W14	30	3.2	98.7	4.03	2.51	27.1	56's	9.4	0.5	1.9
W15	30	3.1	96.3	4.04	2.60	27.9	56's	9.9	0.2	2.6
Total and Averages	120	3.2	97.6	4.01	2.52	27.9	56's	9.7	0.3	2.6
<u>GROUP NO. 3:</u>										
W7	27	3.9	102.9	4.90	2.95	27.0	58's	10.5	0.4	2.1
W8	25	3.8	95.2	4.82	2.92	27.4	56's	10.8	0.6	2.4
W9	26	3.8	98.4	4.59	2.95	27.3	56's	9.6	0.2	1.8
W10	25	3.7	99.8	4.84	3.05	28.5	56's	10.5	0.2	2.2
W11	24	3.9	96.2	4.81	2.99	27.8	56's	10.9	0.4	3.7
Total and Averages	127	3.8	98.6	4.79	2.97	27.6	56's	10.5	0.4	2.4

CHARACTERISTICS OF BREEDING EWES (con't.)

Pen No.	No. of ewes	Age of ewes at lambing (years)	Body weight at 18 mo. (lbs.)	Fleece weight as yearling Grease : Clean (lbs.) (lbs.)	Fineness at side Diameter : Grade (microns)	Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)		
GROUP NO. 6:										
W1	83	4.7	105.0	6.00	3.22	26.5	58's	8.8	0.2	0.8
W2	79	4.4	110.1	6.52	3.35	27.1	56's	9.2	0.2	1.1
W3	81	4.5	106.9	6.06	3.12	26.7	58's	8.7	0.1	0.5
W4	78	4.6	104.8	6.06	3.24	27.0	58's	8.9	0.1	1.1
Total and Averages	321	4.6	106.7	6.16	3.23	26.8	58's	8.9	0.1	0.9
GROUP NO. 7:										
W5	76	4.5	105.2	6.11	3.18	26.8	58's	8.9	0.1	1.0
W6	78	4.6	106.5	5.97	2.92	26.6	58's	8.7	0.1	1.1
Total and Averages	154	4.5	105.9	6.04	3.05	26.7	58's	8.8	0.1	1.1
GROUP NO. 8:										
W16	35	2.0	120.6	7.71	3.70	29.5	50's	10.3	0.0	1.2
W17	35	2.0	120.0	7.88	4.70	33.3	48's	11.5	0.2	3.3
Total and Averages	70	2.0	120.4	7.80	4.20	31.4	50's	10.9	0.1	2.2
GROUP NO. 9:										
W18	28	2.0	117.4	7.08	4.38	34.8	46's	13.3	0.2	2.9
W19	28	2.0	115.6	6.94	4.05	31.8	48's	12.7	0.1	2.2
Total and Averages	56	2.0	116.5	7.01	4.22	33.3	48's	13.0	0.1	2.5

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS

Lamb production of Navajo and crossbred matings in 1948 by groups, pens within groups, and the 11-year 1937-47 averages are summarized in the following table.

The lambs of 1948 were born during the month of May and weaned on September 2. Weaning weights of these lambs were adjusted to a constant age of 120 days, and for differences in type of birth and rearing, and age of dam. The actual values used to make these adjustments will be found on page 32 of this report. The 11-year average weaning weights of Navajo and crossbred lambs were calculated from unadjusted individual weights, taken when the lambs were at an average age of about 140 days.

In all groups the percent of ewes lambing was below the 11-year average. This can be explained partly by the low fertility of several of the rams, especially W 211 I in group 8 and W 126 I in group 9. In groups 6 and 7 too few rams were available for the number of ewes, resulting in a relatively low percentage of pregnancies for most pens. The 1948 average of pregnant ewes in the Navajo pens was slightly below the 11-year average. This no doubt was due to the fact that the average age of the ewes in these pens was 7.5 years. Thus, most of the ewes had passed their most efficient age for lamb production.

In group 1, an increase of 12.2 percent of lambs born of ewes bred compared with the 11-year average for Navajo matings, was due primarily to the increase in percentages of twin lambs born. This high percentage of twin lambs born was also reflected in the pounds of lambs produced per ewe bred. For the crossbred matings, the percentage of lambs born of ewes bred was 92.3 percent, a decrease of 37.4 percent from the 11-year average.

The percentage of lambs weaned of ewes bred, in group 1, was 10.4 percent above the 11-year average for the Navajo matings. Also, the percentage of lambs weaned of ewes bred, in groups 2 to 9 inclusive, was 15.5 percent below the 11-year average for the crossbred matings. The average weaning weight of the Navajo lambs in 1948 was 57.3 pounds, being practically equal to the 11-year average of 57.5 pounds. The average weaning weight of 63.7 pounds, for all lambs produced in groups 2 to 9 inclusive, was 2.6 pounds higher than the 11-year average for crossbred lambs.

In 1948 the Navajo matings produced an average of 64.4 pounds of lamb per ewe bred, exceeding their 11-year average by 5.7 pounds; however, this figure was below the 1947 average by 7.5 pounds. For the crossbred groups 2 to 9 inclusive, the pounds of lamb produced per ewe bred averaged only 50.0 pounds, which was 8.7 pounds below the 11-year average. The large differences between pens, in pounds of lambs produced per ewe bred, were influenced more by the number of ewes lambing than by the weaning weights of the lambs. Thus, the importance of selecting both ewes and rams for their breeding ability should be emphasized in the breeding program.

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS

Pen No.	Ram No.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
GROUP NO. 1:								
1	2I	33	84.8	142.4	100.0	70.2	58.60	58.60
2	15J	24	87.5	158.3	125.0	78.9	53.62	67.03
3	83E	34	82.4	123.5	105.8	85.7	59.39	62.89
4	19H	22	90.9	140.9	127.3	90.3	57.16	72.75
Total and		113	86.6	139.8	112.4	80.4	57.33	64.43
Averages								
GROUP NO. 2:								
W12	17	30	93.3	123.3	115.7	94.6	65.50	76.42
W13	71	30	76.7	106.7	90.0	84.4	60.61	54.56
W14	19	28	85.7	128.6	117.8	91.7	60.20	70.96
W15	83	29	93.1	120.7	103.4	85.7	61.73	63.86
Total and		117	87.2	119.6	106.8	89.3	62.14	66.39
Averages								
GROUP NO. 3:								
W7	5228K	27	100.0	137.0	125.9	91.9	64.97	81.82
W8	4306K	20	70.0	90.0	70.0	77.8	63.53	44.47
W9	5079K	24	70.8	87.5	73.2	90.4	65.60	51.93
W10	5952K	24	87.5	108.3	100.0	92.3	63.16	63.16
W11	5526K	22	100.0	140.9	113.2	83.9	63.36	74.88
Total and		117	86.3	113.7	100.0	88.0	64.17	64.17
Averages								

LAMB PRODUCTION OF NAVAJO AND CROSSBRED MATINGS (con't.)

Pen No.	Ram No.	No. of ewes bred	Percent of ewes lambing	Percent of lambs born of ewes bred	Percent of lambs weaned of ewes bred	Percent of lambs weaned of live lambs born	Average weaning weight in pounds	Pounds of lamb per ewe bred
GROUP NO. 6:								
W1	468	83	68.7	95.2	79.5	83.5	63.24	50.28
W2	87-46	76	65.8	100.0	92.1	92.1	61.47	56.62
W3	108-46	81	49.5	54.3	50.6	93.2	65.10	32.95
W4	51-46	78	83.3	123.0	96.2	78.1	63.70	61.25
Total and Averages		318	66.7	93.4	79.2	84.8	63.40	50.07
GROUP NO. 7:								
W5	1343	75	60.0	82.7	68.0	82.2	64.73	44.01
W6	1381	78	51.3	74.4	53.0	79.3	65.20	38.45
Total and Averages		153	55.5	78.4	63.4	80.8	64.50	41.18
GROUP NO. 8:								
W16	W211I	35	8.6	8.6	8.6	100.0	60.86	5.22
W17	W75I	34	79.4	97.0	91.2	93.9	65.96	60.14
Total and Averages		69	43.4	52.2	49.2	94.4	65.51	32.28
GROUP NO. 9:								
W18	W126I	28	39.3	42.8	32.1	75.0	65.04	20.91
W19	W601I	28	82.1	89.3	64.3	80.0	66.46	42.72
Total and Averages		56	60.7	71.4	48.2	78.4	65.60	33.96
ALL CROSSBRED MATINGS:								
Total and Averages		830	68.0	92.3	78.5	85.1	63.66	50.00
1937-1947 TOTAL AND AVERAGES:								
Navajo Matings		2715	88.2	127.6	102.0	90.0	57.49	58.70
Crossbred Matings		3716	85.9	129.7	94.1	84.1	61.16	57.55

GROWTH RATES OF NAVAJO AND CROSSBRED LAMBS

Body weights of lambs born during the middle two weeks of the 1948 lambing season were taken at 28-day intervals from birth to approximately 120 days of age. Lambs weighed at the various ages included 21 Navajo ram lambs, 198 crossbred ram lambs, 39 Navajo ewe lambs, 307 crossbred ewe lambs, 28 Navajo wether lambs, and 47 crossbred wether lambs. Body weights and average daily rate of gain from birth to weaning age, for each group of lambs is summarized in the following table.

Crossbred lambs, groups 2 to 9 inclusive, were heavier at all ages than the Navajo lambs of group 1. For the ram lambs, the differences in mean weights of the several groups, at 120 days of age, ranged from 18.2 pounds between the heaviest and lightest groups, to 0.4 pound between the heaviest and next heaviest group. For ewe lambs, the difference in weights of the heaviest and the lightest groups was 11.3 pound.

Ram lambs were heavier than ewe lambs at all ages, when all groups were considered; however, the Navajo ewe lambs averaged 2.8 pounds more at 120 days of age than the ram lambs. Navajo wether lambs were heavier than ram lambs, at all ages except at birth.

Average daily rate of gain from birth to 120 days of age was 0.36 of a pound for Navajo ram lambs and 0.38 of a pound for Navajo ewe and wether lambs. Crossbred lambs of groups 2 to 9 inclusive, made a substantially higher rate of gain than Navajo lambs, with averages of 0.47 to 0.50 of a pound for ram lambs; 0.42 to 0.47 of a pound for ewe lambs and 0.41 to 0.50 of a pound for wether lambs. Crossbred lambs of groups 8 and 7 having some inheritance of the Cotswold and Columbia breeds had the highest rates of gain.

The types of matings involved in the breeding program are set up to produce the maximum amount of hybrid vigor in the crossbred lambs. If the matings were planned to maintain the combinations of breeds already made, by interbreeding within the separate groups until all hybrid vigor was lost, presumably there would be less difference in the body weights of lambs produced by straight Navajo matings and the crossbred groups, than appears in the data of this report.

BODY WEIGHTS AND AVERAGE DAILY GAIN
OF NAVAJO AND CROSSBRED LAMBS

Group No.	No. of lambs	Weight in pounds at five ages					Average daily gain in pounds. Birth to 120 da.
		Birth	4 Weeks	8 Weeks	12 Weeks	16 Weeks	
<u>RAMS:</u>							
1	21	7.6	18.6	32.4	43.9	50.5	.36
2	35	8.6	26.0	43.2	57.1	65.3	.47
3	25	9.3	26.2	43.5	58.8	68.3	.49
6	85	9.4	26.6	44.1	58.3	66.1	.47
7	39	9.4	27.5	45.7	59.0	66.2	.47
8	6	8.2	25.1	45.2	59.5	68.7	.50
9	8	8.6	21.9	42.9	59.2	67.9	.49
<u>EWES:</u>							
1	39	7.1	20.0	34.6	46.3	53.3	.38
2	56	7.7	23.0	39.0	51.0	58.1	.42
3	60	8.5	23.0	39.6	52.3	60.0	.43
6	115	8.7	24.7	40.6	52.8	59.8	.42
7	43	9.0	26.6	43.2	55.7	63.4	.45
8	17	7.5	23.2	40.0	53.7	61.5	.45
9	16	8.4	26.4	44.6	56.6	64.6	.47
<u>WETHERS:</u>							
1	28	7.6	20.6	34.6	46.6	53.8	.38
2	10	8.1	24.3	40.7	54.3	62.3	.45
3	12	8.6	21.8	43.2	53.1	60.4	.43
6	16	8.6	22.2	38.6	50.3	57.4	.41
7	5	9.2	24.6	41.0	55.8	64.0	.46
8	3	8.6	26.0	44.0	59.7	68.7	.50
9	1	6.0	24.0	52.0	53.0	61.0	.46

FIBER AND FLEECE CHARACTERISTICS OF WEANLING LAMBS

Wool samples were collected from the middle of the left side and thigh of all ewe, ram, and wether lambs on September 2. These samples were analyzed in the laboratory for the determination of fineness, staple length, and percentages of kemp and other medullated fibers. Fineness and frequency of kemp and other medullated fibers were determined by the rapid count method. Staple length measurements represent an actual 84 days of wool growth. To obtain the samples representing 84 days of wool growth the wool was sheared from a small area of the middle of the left side of each lamb, on the first weight day, June 10. The average age of the lambs at this time was 28 days. On the fourth weigh day, when the lambs were approximately 112 days of age the wool samples were collected from the sheared area and the thigh of each

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the problem and the objectives of the research.

Table 1		Table 2		Table 3		Table 4	
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8

Table 5		Table 6		Table 7		Table 8	
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8

Table 9		Table 10		Table 11		Table 12	
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8
1	2	3	4	5	6	7	8

CONCLUSIONS

The results of the study show that the proposed method is effective in solving the problem. The data indicates that the method is reliable and can be used in a wide range of applications. The study also shows that the method is easy to use and can be implemented in a variety of environments. The results of the study are presented in the following tables.

Table 1 shows the results of the first experiment. The data indicates that the method is effective in solving the problem. The results of the second experiment are shown in Table 2. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the third experiment are shown in Table 3. The data indicates that the method is easy to use and can be implemented in a variety of environments.

The study also shows that the method is effective in solving the problem. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the study are presented in the following tables.

Table 4 shows the results of the first experiment. The data indicates that the method is effective in solving the problem. The results of the second experiment are shown in Table 5. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the third experiment are shown in Table 6. The data indicates that the method is easy to use and can be implemented in a variety of environments.

The study also shows that the method is effective in solving the problem. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the study are presented in the following tables.

Table 7 shows the results of the first experiment. The data indicates that the method is effective in solving the problem. The results of the second experiment are shown in Table 8. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the third experiment are shown in Table 9. The data indicates that the method is easy to use and can be implemented in a variety of environments.

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Table 10 shows the results of the first experiment. The data indicates that the method is effective in solving the problem. The results of the second experiment are shown in Table 11. The data indicates that the method is reliable and can be used in a wide range of applications. The results of the third experiment are shown in Table 12. The data indicates that the method is easy to use and can be implemented in a variety of environments.

lamb. By using this technique adjustments of staple length for age differences of the lambs were unnecessary.

At culling time all lambs were given a numerical score for outercoat. Scoring for outercoat was patterned after similar scoring procedures used for other qualitative characteristics. Numerical values were assigned to each weanling lamb, representing the amount of outercoat covering. A description of the amount of outercoat covering and the numerical value for each follows: "1" No outercoat. The quality of the fleece being similar to that produced by outstanding crossbred type sheep, "2" Outercoat or extreme coarseness evident in the thigh region, "3" Outercoat or hairiness extending from the thigh up over the rump and also along the lower sides, "4" Outercoat or hairiness, in addition to being evident in the locations indicated by a score of three, is slightly noticeable throughout the entire fleece, "5" Extreme hairiness. Outercoat strongly evident throughout the entire fleece.

The scoring range is increased to 15 values by using plus and minus signs with each numerical score.

The following table summarizes, by pens and groups, the fiber characteristics and outercoat scores for the weanling lambs. Data on the thigh samples is not included in the table. Generally, the averages for the thigh samples were at least one grade coarser than the corresponding side samples with consistently higher percentages of kemp and other medullated fibers.

The average fiber diameter for each group of lambs, except group 3, was equivalent to the grade of 56's. Group 3 had an average grade of 58's. Staple length was very satisfactory for all groups. As would be expected, the lambs of groups 6 and 7, sired by Lincoln and Cotswold rams, had the greatest average staple length.

The average percentages of kemp were negligible, for all groups of lambs. Medullated fibers, other than kemp, were present in the samples from some of the lambs of all groups. By careful selection of rams and ewes with no medullated fibers or a low percentage of these fibers, steady progress is being made toward the elimination of this undesirable fleece characteristic.

The straight-bred Navajo lambs of group 1 had the highest average score for outercoat, with a value of 3.78. They were followed by the lambs of groups 6 and 7 with average outercoat scores of 3.70 and 3.60, respectively. The lambs of groups 6 and 7, characterized by open tipped, long stapled fleeces, were probably assigned higher outercoat scores than was actually justified. Present plans call for a more thorough defining of outercoat scores along with photographic standards. This should result in a refinement of the scoring technique, used for outercoat.

FIBER CHARACTERISTICS OF NAVAJO AND CROSSBRED LAMBS
AT WEANING AGE

Pen No.	No. of lambs	Fineness at side Diameter : Grade (microns)		Staple length (cms.)	Kemp (percent)	Other med. fibers (percent)	Outer- coat (score)	
GROUP NO. 1:								
1	36	29.1	50's	3.5	0.0	4.2	3.63	
2	28	29.0	56's	3.4	1.0	3.0	4.15	
3	37	28.1	56's	3.3	.1	2.6	3.37	
4	24	28.9	56's	3.5	.2	3.3	3.81	
Total and Averages		125	28.7	56's	3.4	.3	3.2	3.78
GROUP NO. 2:								
W12	34	27.2	56's	4.9	0.0	2.4	3.61	
W13	27	29.6	50's	4.8	.3	2.9	3.48	
W14	32	28.7	56's	4.6	.0	1.8	3.45	
W15	32	28.0	56's	4.8	.3	1.9	3.21	
Total and Averages		125	28.3	56's	4.8	.1	2.2	3.44
GROUP NO. 3:								
W7	32	27.3	56's	5.4	0.0	3.0	3.48	
W8	13	25.9	58's	5.3	.3	3.0	3.61	
W9	19	25.9	58's	4.2	.1	1.9	3.12	
W10	24	27.0	58's	6.0	.2	4.5	3.34	
W11	27	26.9	58's	5.0	.5	2.0	3.41	
Total and Averages		115	26.8	58's	5.2	.1	2.9	3.39
GROUP NO. 6:								
W1	64	27.8	56's	6.0	0.0	3.8	3.66	
W2	70	28.8	56's	6.5	.0	4.0	3.64	
W3	39	28.6	56's	6.8	.0	2.4	3.60	
W4	72	27.3	56's	6.4	.0	2.0	3.84	
Total and Averages		245	28.1	56's	6.4	.0	3.1	3.70
GROUP NO. 7:								
W5	48	28.6	56's	7.1	0.0	3.9	3.57	
W6	48	28.0	56's	6.7	.0	3.9	3.63	
Total and Averages		96	28.3	56's	6.9	.0	3.9	3.60
GROUP NO. 8:								
W16	3	25.8	58's	5.1	0.0	1.8	3.11	
W17	31	27.7	56's	5.7	.1	2.8	3.36	
Total and Averages		34	27.6	56's	5.7	.1	2.7	3.34
GROUP NO. 9:								
W18	9	28.4	56's	5.3	0.0	2.9	3.59	
W19	21	27.6	56's	5.9	.1	4.8	3.44	
Total and Averages		30	27.9	56's	5.7	.0	4.3	3.49

FACE AND BODY SCORES FOR WEANLING LAMBS

At weaning time, all lambs were scored for face covering, body type, and condition. These scores are summarized by sex, groups, and pens in the following table.

The Navajo ram and ewe lambs of group 1 had less face covering than the crossbred lambs of groups 2 to 9 inclusive, although more variation was found in the Navajo ewe lambs than in the crossbred ewe lambs. The standard deviation for the Navajo ewe lambs was 0.45, and for the crossbred ewe lambs 0.35. The standard deviations for the Navajo ram lambs and crossbred ram lambs were 0.36 and 0.39, respectively. All groups of crossbred lambs were about equal with respect to face covering. The scores indicate less face covering in the ewe lambs than in the ram lambs of all groups.

All groups of crossbred lambs numbered 2 to 9 inclusive, were superior to Navajo lambs of group 1 in body type and condition. Ewe lambs were scored higher for type and condition than ram lambs, and the standard deviations for both traits were smaller for the ewes than for the rams, indicating less variation among the ewe lambs. The ewe lambs in group 9 were superior to all other crossbred groups in both type and condition, and the ram lambs in group 9 were given the best type score. Ram lambs in group 8 had more condition than the ram lambs of any other group. It appears that the combinations of breeding represented in groups 8 and 9, having some inheritance from the Cotswold and Columbia breeds, will be beneficial in improving the quality of lambs produced.

FACE AND BODY SCORES FOR NAVAJO AND CROSSBRED LAMBS AT WEANING AGE

RAM LAMBS					EWE LAMBS			
Face					Face			
Pen No.	No. of lambs	covering (score)	Type (score)	Condition (score)	No. of lambs	covering (score)	Type (score)	Condition (score)
<u>GROUP NO. 1:</u>								
1	18	2.91	2.99	2.67	19	2.87	3.06	2.69
2	18	2.63	3.23	3.01	12	2.37	3.26	2.89
3	19	2.84	3.10	2.93	18	2.75	2.92	2.66
4	17	2.95	3.06	2.81	10	3.05	2.95	2.74
Total and Averages	72	2.83	3.10	2.88	59	2.76	3.04	2.73
<u>GROUP NO. 2:</u>								
W12	19	3.19	2.55	2.57	15	3.07	2.44	2.37
W13	11	2.91	2.55	2.44	16	2.88	2.31	2.18
W14	16	3.52	2.77	2.70	16	3.34	3.87	2.31
W15	13	3.17	2.49	2.32	18	3.14	2.51	2.34
Total and Averages	59	3.22	2.58	2.53	65	3.13	2.78	2.30
<u>GROUP NO. 3:</u>								
W7	14	3.30	2.73	2.43	18	3.24	2.53	2.39
W8	5	3.23	2.70	2.43	8	3.02	2.36	2.15
W9	7	3.00	2.62	2.26	12	2.94	2.35	2.22
W10	8	2.96	2.21	2.11	16	2.67	2.43	2.17
W11	11	3.00	2.52	2.36	16	3.02	2.63	2.49
Total and Averages	45	3.11	2.56	2.33	70	2.97	2.48	2.31
<u>GROUP NO. 6:</u>								
W1	30	3.12	2.46	2.39	34	2.95	2.40	2.16
W2	25	3.00	2.27	2.32	41	2.96	2.31	2.13
W3	17	2.89	2.40	2.33	22	2.86	2.32	2.31
W4	40	3.19	2.48	2.40	31	3.14	2.48	2.31
Total and Averages	112	3.06	2.42	2.37	128	2.99	2.36	2.21
<u>GROUP NO. 7:</u>								
W5	21	3.20	2.35	2.51	28	3.10	2.20	2.11
W6	27	3.47	2.54	2.67	17	3.20	2.65	2.37
Total and Averages	48	3.35	2.46	2.60	45	3.14	2.36	2.21
<u>GROUP NO. 8:</u>								
W16	0	0.00	0.00	0.00	3	3.45	2.50	2.67
W17	13	3.10	2.46	2.21	18	3.07	2.39	2.26
Total and Averages	13	3.10	2.46	2.21	21	3.12	2.41	2.32
<u>GROUP NO. 9:</u>								
W18	2	2.75	2.25	2.42	7	3.24	2.12	2.10
W19	9	2.83	2.37	2.21	12	3.04	2.40	2.25
Total and Averages	11	2.80	2.35	2.25	19	3.11	2.30	2.19

SELECTION PRACTICED ON NAVAJO AND CROSSBRED LAMBS

During the week of October 20 the lambs were sorted into pens according to sex and sire to facilitate the work of selection and culling. The lambs of each pen were considered individually for the various characteristics evaluated at about 120 days of age, including body weight, type, condition, face covering, color, staple length, grade of fleece, percentages of kemp and other medullated fibers, and outercoat score. Also, each pen of lambs was scored as a group for size, type, condition, face covering, and fleece quality, and for uniformity in these characteristics. Defects or outstanding characteristics were noted. The degree of selection practiced on each pen of lambs depended upon the merit of the lambs individually, and the quality and uniformity of the pen of lambs as a unit.

A total of 446 lambs were saved and 321 were culled. In group 1, consisting of Navajo lambs, the percentages of rams and ewes saved were 19 and 93, respectively. Culling of Navajo ewe lambs was held to a minimum because of the small number of lambs produced, and the urgent need for replacements adequate to maintain present numbers of Navajo breeding ewes. In groups 2 to 9 inclusive of crossbred lambs, about 37 percent of the rams and 78 percent of the ewes were retained for prospective breeding use.

The percentage of lambs saved in each group, the selection differentials for most of the weanling traits, along with the relative emphasis placed on each trait at culling time, and the expected genetic gain are given in the following table.

The relative emphasis placed on each trait was calculated by dividing the selection differential by the standard deviation for that trait. The relative emphasis placed on the various traits varied somewhat for the several groups of lambs, but in general the greatest emphasis was placed on weaning weight, followed by type. Selection against kemp and coarse outercoat fibers automatically resulted in some selective pressure against staple length and coarse fiber diameter, since both length and average fiber diameter are influenced by these objectionable coarse fibers when present in the fleece. The incidence of kemp has been reduced to a very low level by rigid selection over a period of 12 years, but hair fibers are more persistent in the fleeces, which necessitates the culling of lambs for this characteristic, throughout several generations.

The expected genetic gain from selections made was obtained by multiplying the selection differential by the heritability value for that trait. Since no heritability estimates have been computed for these traits, at this station, heritability estimates obtained for range Rambouillet lambs at Dubois, Idaho, have been used. To the extent that these heritability estimates are representative of the lambs at this station, the estimates of the genetic gain represents how much the selective groups are superior in actual breeding value to the unselected groups from which they were chosen.

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1948 WEANLING LAMBS

Group No.	Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent Saved
1	Rams	Advantage of selected lambs	2.54	.00	-.52	.07	.04	-.12	.73	.39
		Relative emphasis	.37	.00	-.30	.19	.11	-.27	.60	.44
		Expected genetic gain	.81	.00	--	.04	.00	.00	--	--
	Ewes	Advantage of selected lambs	-.07	.00	.00	.02	.00	-.01	.02	.04
		Relative emphasis	-.01	.00	.00	.04	.00	-.02	.01	.05
		Expected genetic gain	-.02	.00	--	.01	.00	.00	--	--
2	Rams	Advantage of selected lambs	3.82	-.36	1.21	.10	.40	.21	.58	-.10
		Relative emphasis	.54	-.35	.49	.24	.80	.46	.40	-.14
		Expected genetic gain	1.22	-.14	--	.06	.05	.01	--	--
	Ewes	Advantage of selected lambs	1.42	-.04	-.14	-.01	.00	.08	.03	.02
		Relative emphasis	.20	-.03	-.06	-.03	.00	.16	.03	.03
		Expected genetic gain	.45	-.02	--	.00	.00	.00	--	--
3	Rams	Advantage of selected lambs	4.30	-.52	.34	.06	.16	.08	.21	.04
		Relative emphasis	.53	-.29	.22	.17	.33	.18	.20	.05
		Expected genetic gain	1.38	-.21	--	.03	.02	.00	--	--
	Ewes	Advantage of selected lambs	.55	-.42	-.05	.00	.01	.02	.05	.13
		Relative emphasis	.10	-.24	-.02	.00	.03	.07	.12	.17
		Expected genetic gain	.18	-.17	--	.00	.00	.00	--	--
6	Rams	Advantage of selected lambs	4.91	-.52	.13	.04	.31	.15	.20	.18
		Relative emphasis	.64	-.25	.06	.11	.61	.32	.22	.27
		Expected genetic gain	1.57	-.20	--	.02	.04	.01	--	--
	Ewes	Advantage of selected lambs	2.25	-.28	.17	.06	.13	.10	-.06	.12
		Relative emphasis	.35	-.14	.08	.16	.41	.18	-.09	.17
		Expected genetic gain	.82	-.11	--	.03	.02	.00	--	--

SELECTION DIFFERENTIALS, RELATIVE EMPHASIS, AND EXPECTED GENETIC GAIN FOR 1948 WEANLING LAMBS (con't.)

Group No.	Sex	Weaning weight (lbs.)	Staple length (cms.)	Fiber diameter (microns)	Face covering (score)	Type (score)	Condition (score)	Color (score)	Outer-coat (score)	Percent saved
7	Rams	Advantage of selected lambs	3.38	-.37	-.11	.12	.18	.18	.10	
		Relative emphasis	.55	-.22	-.05	.70	.34	.19	.15	35.42
		Expected genetic gain	1.08	-.15	--	.06	.01	--	--	
	Ewes	Advantage of selected lambs	1.54	.03	-.12	.03	.03	.02	.02	
		Relative emphasis	.22	.01	-.06	.23	.06	.01	.02	73.33
		Expected genetic gain	.49	.01	--	.02	.00	--	--	
8	Rams	Advantage of selected lambs	2.84	-.30	.55	-.20	.14	.00	.08	
		Relative emphasis	.67	-.25	.24	-.56	.27	.00	.17	38.46
		Expected genetic gain	.91	-.10	--	-.11	.01	--	--	
	Ewes	Advantage of selected lambs	2.07	-.40	.11	.04	.12	-.17	.17	
		Relative emphasis	.31	-.22	.05	.11	.34	-.13	.22	76.19
		Expected genetic gain	.66	-.13	--	.02	.00	--	--	
9	Rams	Advantage of selected lambs	2.89	.05	-.10	.06	.03	.04	-.10	
		Relative emphasis	.34	.05	-.10	.26	.05	.04	-.27	63.64
		Expected genetic gain	.92	.02	--	.03	.00	--	--	
	Ewes	Advantage of selected lambs	2.27	-.34	.82	.05	.11	.01	.18	
		Relative emphasis	.32	-.31	.35	.12	.24	.01	.21	73.68
		Expected genetic gain	.72	-.14	--	.03	.00	--	--	
All Cross-bred Groups	Rams	Advantage of selected lambs	4.25	-.43	-.27	.07	.16	.26	.08	
		Relative emphasis	.58	-.22	-.13	.28	.14	.24	.07	36.81
		Expected genetic gain	1.36	-.17	--	.04	.01	--	--	
	Ewes	Advantage of selected lambs	1.71	-.27	.02	.03	.07	-.01	.10	
		Relative emphasis	.25	-.13	.00	.09	.14	-.01	.14	77.87
		Expected genetic gain	.55	-.11	--	.02	.00	--	--	

The estimated annual genetic improvement from weanling selections would be the sum of the expected genetic gains of the ram lambs and the ewe lambs, divided by the total age of the sires and dams when the offspring are born. These rates for the weanling traits in 1947, along with the average age of the parents, are presented in the following table:

Breeding Group	Average of Dams (years)	Average of Sires (years)	Average of Sires plus Dams (years)	Weaning weight (lbs.)	Staple length (cm.)	Face covering (score)	Type (score)	Condition (score)
1	7.40	3.00	10.40	.076	.000	.005	.000	.000
2	3.20	2.50	5.70	.016	-.002	.006	.005	.001
3	3.80	3.20	7.00	.150	-.030	.003	.002	.000
6	4.60	2.25	6.85	.230	-.030	.005	.006	.001
7	4.50	3.50	8.00	.151	-.013	.008	.005	.001
8	2.00	2.00	4.00	.151	-.022	-.001	.004	.001
9	2.00	2.00	4.00	.184	-.027	.006	.005	.001

The average ages of sires and dams have remained fairly constant from 1944 to 1948, with the exception of the straight Navajo matings, and in this case the ewes have steadily increased in age. The ages of the ewes and rams in the breeding flock from 1944 to 1948 are given in the following table:

Breeding Group	Ewes				Rams			
	1944-45	1946	1947	1948	1944-45	1946	1947	1948
1	4.20	5.10	5.70	7.40	1.80	4.00	3.00	3.00
2	-	-	4.10	3.20	-	-	1.70	2.50
3	-	4.60	3.50	3.80	-	2.80	3.50	3.20
6	-	-	4.70	4.60	-	-	2.00	2.25
7	-	4.30	4.70	4.50	-	2.00	3.00	3.50
8	-	-	-	2.00	-	-	-	2.00

SIZE OF LAMBS AT WEANING AS A PERMANENT CHARACTERISTIC OF NAVAJO EWES

Weaning weights of lambs represent one of the two major sources of income from range sheep production. The ability of a ewe to wean heavy lambs is important and considerable emphasis should be placed on this trait when a ewe in the flock is culled or retained for future breeding.

Before a figure for repeatability of lamb production for the ewes can be computed, the effects of the measurable environmental factors on the growth rates of the lambs needs to be known, and adjustments or corrections made for them.

The estimates of the values for these environmental factors have been computed for weaning weights of lambs born of Navajo ewes, and are given in the following table.

All of the sources of variation proved to be statistically significant. The intraclass correlation of lambs raised by the same ewe, which represents the degree to which weaning weights of lambs is a constant characteristic of the ewes, was found to be .217. This figure has its greatest value in selecting ewes for their ability to wean heavy lambs when that ewe has had one or more lambs. When two or more lambs have been raised, the most probable producing ability of the ewe can be computed. When this information is available on each ewe in the flock, accurate selection for lamb production can be practiced.

In addition to the value of adjusting the weights of lambs for comparing without bias the producing ability of each ewe, these estimates of the effects of environmental factors have an important use in making adjustments so that accurate selection can be made among the lambs at weaning time with respect to body weight.

ESTIMATES OF THE MEASURABLE ENVIRONMENTAL FACTORS EFFECTING
THE GROWTH RATE OF WEANLING LAMBS

<u>Measurable environmental factors</u>		<u>Estimates of value of each environmental factor</u>
YEARS	1938	0.00
	1939	5.20
	1940	4.30
	1941	-6.90
	1942	-1.60
	1943	- .80
	1944	4.00
	1945	-3.20
	1946	5.20
	1947	-6.50
AGE GROUP OF EWES	2 years	1.80
	3 years	-1.50
	4-7 years	-1.70
	8-11 years	1.40
BREEDING OF SIRE	Navajo	1.40
	Corriedale	-1.10
	Romney	2.30
	Crossbred	- .60
	Columbia	-2.00
TYPE OF BIRTH AND REARING	Single	-4.70
	Twin	6.50
	Twin raised	-1.80
	as single	
SEX	Rams	-2.20
	Ewes	2.20
AGE OF LAMBS IN DAYS	Regression of weight on age	.37

PROGRESS IN FLEECE IMPROVEMENT OF NAVAJO SHEEP

The foundation flock of sheep at this laboratory consisted of about 800 old-type Navajo ewes and rams purchased in 1935 and 1936 from Indian-owned flocks. The fleeces of these sheep possessed, in general, the same characteristics as carpet wools produced in other parts of the world and as such were considered carpet wools in the domestic market. Characteristics of the original Navajo-type fleeces were: (1) an outercoat of coarse, long, hair-like fibers, often medullated, (2) an undercoat of shorter, finer fibers with the general qualities of improved wools, and (3) varying quantities of opaque, brittle, short kemp fibers.

From the beginning attempts at fleece improvement have been directed toward the elimination of the hairy outercoat fibers along with medullation, as well as the more objectionable kemp fibers. To effect an improvement, rigid selection against these characteristics has been practiced in the breeding program.

A definite measure of the amount of hairy outercoat was difficult to obtain. However, visual inspection of the fleeces of the younger Navajo ewes compared with the fleeces of the older ewes showed that definite improvement has been made. Many of the younger Navajo ewes are producing a non-hairy type of fleece with some of the characteristics and qualities of improved wools. Medullation continues to be a problem for selection. That this objectionable characteristic is being eliminated is shown by the fact that in 1940 the 636 mature Navajo ewes in the breeding flock produced fleeces containing an average of 9 percent of medullated fibers, other than kemp, whereas the fleeces of 75 unselected Navajo yearlings of 1948 had an average of only 1.1 percent of medullated fibers other than kemp.

Progress toward the elimination of kemp fibers in the fleeces of Navajo sheep is apparent in the following table:

Frequency Interval Percent of Kemp	Number of Ewes	Percent of Ewes
1940 Breeding Flock:		
0.0	0	0.00
.1 - .9	260	40.88
1.0 - 2.9	227	35.69
3.0 - 4.9	108	16.98
5.0 or more	41	6.45
TOTAL	636	100.00
1948 Yearling Ewes:		
0.0	71	94.67
.1 - .9	1	1.33
1.0 - 2.9	0	.00
3.0 - 4.9	2	2.67
5.0 or more	1	1.33
TOTAL	75	100.00

The mean values of the percent of kemp, 2.0 percent for the 1940 breeding flock and 0.2 percent for the 1948 yearling ewes, further illustrate that kemp has been largely eliminated from the fleeces of these sheep. Although selection against kemp is practiced, it is no longer a major problem in the breeding program.

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED EWES

All yearling ewes were scored for face covering and color just prior to shearing. Body weights, type scores, and condition scores were taken immediately after the ewes were sheared. These weights and scores for 285 crossbred ewes and 75 Navajo ewes are summarized in the following table.

Average body weight of the Navajo ewes in group 1 was 8.4 pounds below the average of all crossbred ewes in groups 2 to 7 inclusive. Also the Navajo ewes were less desirable than the crossbred ewes with respect to type and condition. Navajo ewes had less face covering, however, than any of the crossbred groups, and were about average as to color score. All groups were sufficiently open faced to preclude any wool blindness. Hence face covering was not a factor in the ewes ability to find feed, and therefore had little or no effect on their body weights. However, constant care must be exercised to prevent wool blindness from becoming a problem in the breeding flock.

The ewes of group 3 were the heaviest of all groups at yearling age, followed by groups 7 and 6, respectively. Group 7 had the most desirable type and were scored best for condition, but less desirable as to face covering. These same characteristics of the groups were also observed in the yearling ewes in 1947.

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED EWES

Pen no.	No. of ewes	Body weight (pounds)	Face covering (score)	Type (score)	Condition (score)	Color (score)
<u>GROUP NO. 1:</u>						
1	19	85.9	2.75	3.04	2.83	1.22
2	18	86.9	2.52	2.99	2.71	1.22
3	38	89.6	2.59	2.92	2.58	1.46
Total and Averages	75	86.8	2.58	2.97	2.68	1.32
<u>GROUP NO. 2:</u>						
W17	13	91.6	2.81	2.51	2.08	1.46
W18	15	97.1	2.90	2.33	1.86	1.73
W19	21	89.8	2.88	2.27	2.03	1.19
Total and Averages	49	92.5	2.87	2.32	1.99	1.42
<u>GROUP NO. 3:</u>						
W3	13	103.3	2.78	2.12	1.69	1.42
W9	11	102.5	2.97	2.11	2.06	1.09
W10	10	98.1	2.74	2.00	1.65	1.00
W11	10	99.4	2.90	2.20	2.09	1.40
Total and Averages	44	101.0	2.85	2.11	1.86	1.23
<u>GROUP NO. 4:</u>						
W1	11	93.1	2.83	2.30	1.80	1.45
W2	8	88.4	2.75	2.21	1.86	1.63
W3	10	89.5	2.62	2.70	2.22	1.40
W4	7	94.7	2.74	2.67	2.36	1.28
Total and Averages	36	91.4	2.74	2.46	2.04	1.44
<u>GROUP NO. 5:</u>						
W5	16	91.9	2.96	2.50	2.35	1.25
W6	12	93.8	2.78	2.20	1.99	1.33
W7	21	89.5	2.74	2.65	2.37	1.05
Total and Averages	49	91.3	2.82	2.49	2.27	1.18
<u>GROUP NO. 6:</u>						
W12	16	97.4	2.41	2.05	1.87	1.71
W13	18	94.9	2.85	2.30	2.10	1.76
W14	31	94.8	2.91	2.22	1.98	1.16
Total and Averages	65	95.5	2.86	2.20	1.99	1.45
<u>GROUP NO. 7:</u>						
W15	19	103.5	3.15	2.21	1.94	1.29
W16	23	94.6	2.79	2.03	1.75	1.65
Total and Averages	42	98.6	2.96	2.11	1.84	1.49
<u>TOTAL AND AVERAGE ALL CROSSBRED GROUPS:</u>						
	285	95.2	2.85	2.28	2.00	1.37

BODY WEIGHTS AND SCORES OF YEARLING NAVAJO AND CROSSBRED RAMS

Six Navajo yearling rams and 101 crossbred yearling rams were scored for face covering and color just prior to shearing. Body weights and type and condition scores were taken immediately after shearing. These data are summarized by groups in the following table:

Group No.	No. of Rams	Body weight (pounds)	Face covering (score)	Type (score)	Condition (score)	Color (score)
1	6	115.2	2.23	3.20	2.96	1.17
2	24	139.7	2.75	2.75	2.22	1.58
3	18	144.4	2.69	2.68	2.22	1.26
4	11	123.2	2.87	2.88	2.55	1.27
5	11	127.9	2.86	2.79	2.47	1.10
6	23	129.2	2.62	2.73	2.28	1.35
7	14	133.0	2.98	2.71	2.26	1.36

The rams in group 3, with an average weaning weight of 144.4 pounds, were 29.2 pounds heavier than the Navajo rams, and exceeded the averages of the other groups from 4.7 to 21.2 pounds. All crossbred rams exceeded the Navajo rams in body weight. In 1948 each crossbred group average was heavier than the corresponding group average in 1947. There was no difference in the Navajo yearling ram weights in 1947 and 1948.

Group 3 rams were also superior to all other groups in body type and condition. Navajo rams had less face covering than any other group, although all groups were definitely open faced. The rams of group 2 had slightly more color on the face and legs than did any other group of rams. All groups in 1948 had more desirable scores for color than was observed in 1947.

THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

REPORT OF THE

COMMISSIONERS OF THE

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FOR THE YEAR

1900-1901

CHICAGO, ILL.

1901

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED EWES

Sampling and laboratory procedures for the yearling ewes were the same as has been previously described. Data on the fleece production and fiber characteristics of the yearling ewes are summarized in the following table.

In 1948 the straight-bred Navajo yearling ewes, group 1, exhibited a marked improvement in fleece production, compared with the Navajo yearlings of the previous three years. As elsewhere indicated in this report, considerable wool shedding occurred in the flock prior to shearing, in the years 1945, 1946, and 1947. No shedding occurred in the yearlings before shearing in 1948. With an average clean fleece weight of 3.36 pounds the production of the 1948 Navajo yearling ewes exceeded the 12-year average clean fleece weight of the Navajo yearling ewes by 0.5 pound. This fact should indicate that fleece weights are not being sacrificed in the breeding program with Navajo sheep, as a result of selection against hair and kemp. The fleeces of the Navajo yearling ewes were distributed through the grades of 60's to 48's inclusive, with an average grade of 56's. Staple length was very satisfactory, with an average of 12.5 centimeters. The average percentages of kemp and other medullated fibers were very low.

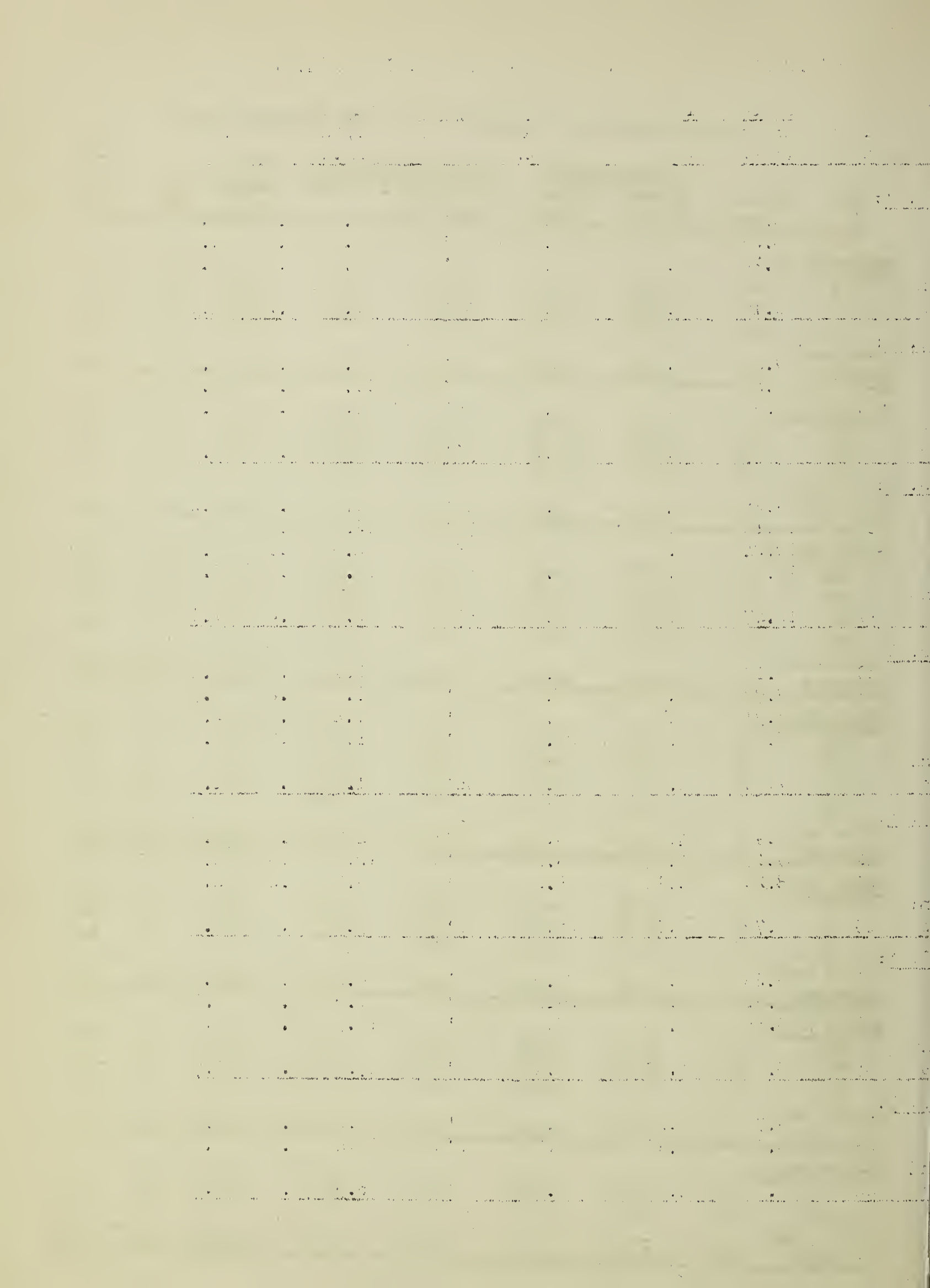
The yearling ewes of group 2, sired by Romney rams, and the yearlings of group 3, sired by Columbia rams, produced fleeces of a desirable character. The Columbia sired yearlings produced heavier fleeces, both grease and clean, with a greater average staple length than the yearlings of group 2, although the average fiber diameter of both groups was equivalent to the grade of 56's. Kemp fibers were noticeably lacking in both groups and the percentages of other medullated fibers were not objectionably high.

Since groups 4 and 5 are no longer included in the breeding program, the yearling ewes of these groups will be assigned to groups 6 and 7, at breeding time. Fleeces of these yearling ewes had a desirable character, but averaged two grades finer than the desired 48's.

The yearling ewes of group 7, sired by Cotswold rams, were superior in all characteristics except average fleece grade to the Lincoln sired yearlings of group 6. Although the average fiber diameter of the group 7 yearlings was 1.3 microns coarser than the average of group 6, the average grade of 50's was the same for both groups. Kemp fibers were lacking in both groups. The average percentages of medullated fibers, other than kemp, were 3.5 and 3.0, for groups 6 and 7, respectively. The general fleece quality, characterized by a long staple with a bold, open crimp, was very satisfactory for both groups.

WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED EWES

Pen No.	No. of ewes	Fleece weight		Fineness at side		Staple length (cms.)	Kemp (%)	Other
		Grease : (lbs.)	Clean (lbs.)	Diameter : (microns)	Grade			med. fibers (%)
GROUP NO. 1:								
1	19	6.09	3.46	28.3	56's	12.7	0.0	1.0
2	18	6.23	3.56	27.7	56's	12.6	.8	1.5
3	38	6.22	3.22	28.1	56's	12.4	.0	1.0
Total and Averages	75	6.19	3.36	28.1	56's	12.5	.2	1.1
GROUP NO. 2:								
W17	13	9.44	3.56	28.6	56's	10.5	0.0	1.4
W18	15	8.41	3.68	28.4	56's	11.0	.0	4.1
W19	22	7.32	3.57	27.9	56's	9.9	.0	0.8
Total and Averages	50	8.20	3.60	28.2	56's	10.4	.0	1.9
GROUP NO. 3:								
W8	13	9.28	4.49	27.7	56's	11.9	0.0	2.4
✓ W9	11	12.15	5.30	27.7	56's	12.5	.0	2.7
W10	10	10.24	4.52	26.5	58's	12.0	.1	1.0
W11	10	10.38	4.72	27.1	56's	12.0	.0	2.0
Total and Averages	44	10.47	4.75	27.3	56's	12.1	.0	2.1
GROUP NO. 4:								
W1	11	8.17	3.92	27.1	56's	12.1	0.0	0.4
W2	8	7.78	3.65	28.3	56's	11.5	.2	2.5
W3	10	6.31	3.10	28.7	56's	11.4	.0	2.5
W4	7	8.57	3.79	26.0	58's	11.9	.0	1.5
Total and Averages	36	7.64	3.61	27.6	56's	11.8	.0	1.7
GROUP NO. 5:								
W5	16	8.92	4.08	29.6	50's	14.0	0.2	9.3
W6	12	9.29	4.34	29.4	50's	12.6	.0	4.5
W7	21	8.20	4.18	28.2	56's	13.7	.4	4.5
Total and Averages	49	8.70	4.19	28.9	56's	13.5	.2	6.0
GROUP NO. 6:								
W12	16	9.23	4.15	29.3	50's	14.0	0.0	4.0
W13	18	8.31	3.98	29.4	50's	12.6	.0	4.0
W14	31	8.55	3.95	28.8	56's	13.3	.0	2.9
Total and Averages	65	8.65	4.00	29.1	50's	13.3	.0	3.5
GROUP NO. 7:								
W15	19	9.79	4.44	30.0	50's	16.2	0.0	2.9
✓ W16	23	8.56	4.11	30.7	50's	16.4	.0	3.0
Total and Averages	42	9.12	4.26	30.4	50's	16.3	.0	3.0



WOOL PRODUCTION OF YEARLING NAVAJO AND CROSSBRED RAMS

Sampling procedures and laboratory techniques for obtaining the fleece production and fiber characteristics of the yearling rams were the same as has been previously described. Very rigid selection was practiced on both fleece characteristics and body type before rams were retained for use in the breeding program. The following table lists the average fleece production and fiber characteristics of the yearling rams, by the various breeding groups.

The six straight-bred Navajo rams were retained for possible replacements in the Navajo breeding program. These rams produced improved fleeces containing little or no outercoat, with an average grade of the desired 48's. No kemp fibers were found in the samples from these rams and only 1.2 percent of other medullated fibers were present.

The yearling rams of the various crossbred matings, groups 2 to 7, produced fleeces of good quality and weight with a desirable crossbred character. With an average clean fleece weight of 6.21 pounds, the Cotswold sired yearling rams, of group 7, were the heaviest producers of wool. Next were the Columbia sired rams of group 3, with an average clean fleece weight of 5.87 pounds. The average fleece grade for the rams of groups 2, 6, and 7, was 48's, and for rams of groups 3, 4, and 5 the average grade was 50's. The average staple length of all groups of rams was very satisfactory. Kemp fibers were noticeably lacking in all groups and the average percentages of other medullated fibers for each group was below one percent.

No. of rams	<u>Fleece weight</u>		<u>Fineness at side</u>		Staple length (cms.)	Kemp (%)	Other med. fibers (%)
	Grease : Clean (lbs.)	Clean (lbs.)	Diameter : Grade (microns)				
<u>GROUP NO. 1:</u>							
6	7.78	4.01	32.0	48's	17.7	0.0	1.2
<u>GROUP NO. 2:</u>							
24	11.00	4.66	32.0	48's	12.0	.0	.3
<u>GROUP NO. 3:</u>							
18	12.96	5.87	29.6	50's	15.1	.0	.2
<u>GROUP NO. 4:</u>							
11	10.72	5.14	30.2	50's	14.5	.0	.1
<u>GROUP NO. 5:</u>							
11	11.07	4.95	31.4	50's	15.0	.0	.2
<u>GROUP NO. 6:</u>							
23	10.60	5.24	32.9	48's	16.0	.0	.2
<u>GROUP NO. 7:</u>							
14	11.79	6.21	33.2	48's	16.9	.0	.7

SUMMARY OF WEIGHTS OF SORTS OF YEARLING CROSSBRED EWE AND RAM FLEECES

Data on the weights and grades of crossbred yearling ewe and ram fleeces, the percentages of main sorts and the weights of main and off sorts are summarized in the following table.

A total of 188 crossbred yearling ewe fleeces were sorted. The fleeces of ewes in groups 4 and 5 were sent to the Denver Wool Laboratory for core sampling and shrinkage determination, and therefore were not included in the wool sorting work. The results show that the yearling ewes of group 2, sired by Romney rams, had the lowest average percentage of main sorts in their fleeces, with only 55.00 percent of matchings, as well as the lowest average fleece weight. With an average of 66.09 percent the yearling ewes of group 3, sired by Columbia rams, produced the highest average percentage of main sorts. The average percentages of main sorts for the yearling ewes of groups 6 and 7 were 61.22 percent and 63.99 percent, respectively. The ewes of group 6 were sired by Lincoln rams and the ewes of group 7 were sired by Cotswold rams. The average percentage of main sorts from the fleeces of all yearling ewes was 61.67 percent. There was no consistent relationship between fleece grade and the average percentage of main sorts from the fleeces of the yearling ewes, either within a group or between the various groups.

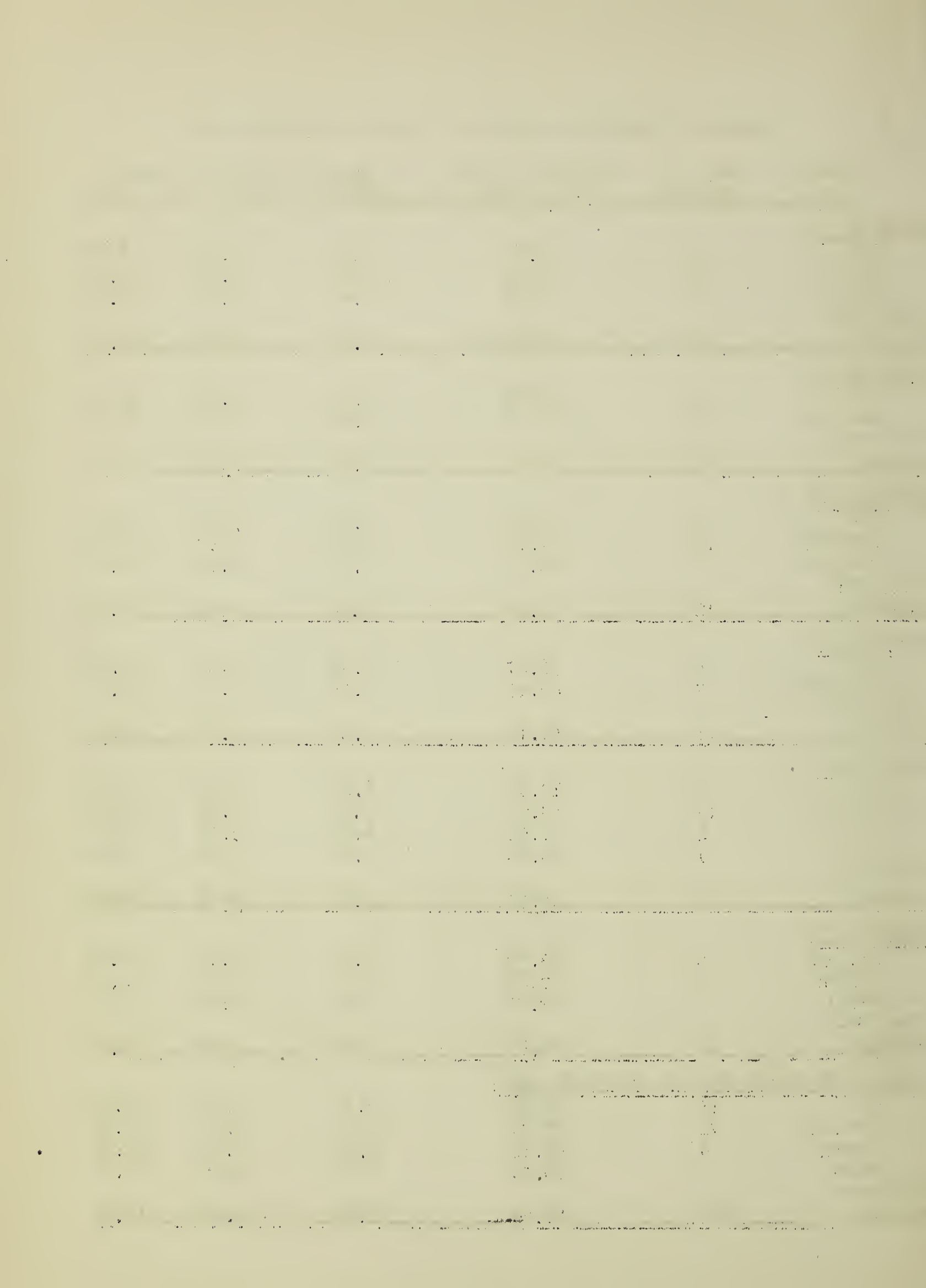
The percentages of main sorts for the various groups of yearling rams did not follow the same pattern of distribution as obtained for the yearling ewes. The yearling rams of group 7 had the highest average percentage of main sorts, with 64.57 percent. Next highest were the rams of group 3, with an average of 60.41 percent. The fleeces from the rams of group 5 yielded 59.15 percent of main sorts, followed by group 4 with 57.56 percent of main sorts. The rams of group 2, with 56.79 percent of main sorts, produced a higher percentage of main sorts than the rams of group 6. The average percentage of main sorts for the 101 ram fleeces sorted was 58.74 percent. In the case of the ram fleeces there was a consistent relationship between the fleece grade and the percent of main sorts. As the fleece grade became coarser the percentage of matchings increased for all groups of yearling rams.

SUMMARY OF WEIGHTS OF SORTS OF YEARLING CROSSBRED EWES

Fleece grade	No. of fleeces	Percent of main sorts in fleeces	Average Weight in Pounds		
			Main sorts	Off sorts	Total
GROUP NO. 2:					
3/8	1	65.78	3.23	1.68	4.91
1/4	6	55.54	3.97	3.18	7.15
Low 1/4	32	50.89	4.11	3.97	8.08
Common	6	73.34	6.57	2.39	8.96
Total and Averages	45	55.00	4.40	3.60	8.00
GROUP NO. 3:					
3/8	3	56.07	5.42	4.25	9.67
1/4	8	69.92	6.75	2.90	9.65
Low 1/4	24	65.75	6.48	3.38	9.86
Common	8	66.96	7.28	3.59	10.87
Total and Averages	43	66.09	6.60	3.39	9.99
GROUP NO. 6:					
1/4	4	65.88	4.99	2.58	7.57
Low 1/4	33	62.94	5.11	3.01	8.12
Common	23	59.96	5.24	3.50	8.74
Low Braid	3	49.95	5.15	5.16	10.31
Total and Averages	63	61.22	5.15	3.26	8.41
GROUP NO. 7:					
Low 1/4	7	71.21	6.20	2.50	8.70
Common	19	61.03	5.67	3.62	9.29
Braid	5	64.54	5.90	3.24	9.14
Low Braid	6	65.46	4.33	2.29	6.62
Total and Averages	37	63.99	5.58	3.14	8.72
AVERAGES BY GRADE FOR ALL YEARLING EWES:					
3/8	4	57.48	4.87	3.61	8.48
1/4	18	65.00	5.43	2.92	8.35
Low 1/4	96	60.57	5.20	3.38	8.58
Common	56	62.89	5.82	3.44	9.26
Braid	5	64.54	5.90	3.24	9.14
Low Braid	9	58.66	4.60	3.24	7.84
Total and Averages	188	61.67	5.39	3.35	8.74

SUMMARY OF WEIGHTS OF SORTS OF YEARLING CROSSBRED RAMS

Fleece grade	No. of fleeces	Percent of main sorts in fleeces	Average Weight in Pounds		
			Main sorts	Off sorts	Total
GROUP NO. 2:					
1/4	4	53.84	5.21	4.47	9.68
Low 1/4	16	56.54	6.00	4.61	10.61
Common	2	63.48	7.47	4.30	11.77
Total and Averages	22	56.79	5.99	4.56	10.55
GROUP NO. 3:					
1/4	5	58.88	7.03	4.91	11.94
Low 1/4	15	60.89	7.73	4.96	12.69
Total and Averages	20	60.41	7.56	4.95	12.51
GROUP NO. 4:					
1/4	1	0.00	0.00	9.86	9.86
Low 1/4	10	61.75	6.45	3.99	10.44
Common	1	68.80	7.96	3.61	11.57
Total and Averages	12	57.56	6.04	4.45	10.48
GROUP NO. 5:					
1/4	4	56.67	5.70	4.36	10.06
Low 1/4	7	60.45	6.65	4.35	11.00
Total and Averages	11	59.15	6.31	4.36	10.67
GROUP NO. 6:					
1/4	1	13.95	1.22	7.55	8.77
Low 1/4	17	53.93	5.67	4.84	10.51
Common	4	67.64	6.54	3.13	9.67
Braid	1	75.33	7.38	2.42	9.80
Total and Averages	23	55.58	5.70	4.56	10.26
GROUP NO. 7:					
Low 1/4	9	63.00	7.07	4.15	11.22
Common	2	67.05	8.27	4.06	12.33
Braid	2	68.56	8.34	3.82	12.16
Total and Averages	13	64.57	7.45	4.09	11.54
AVERAGES BY GRADES FOR ALL YEARLING RAMS:					
1/4	15	50.88	5.34	5.15	10.49
Low 1/4	74	58.80	6.53	4.57	11.10
Common	9	66.64	7.29	3.65	10.94
Braid	3	70.50	8.02	3.35	11.37
Total and Averages	101	58.74	6.46	4.54	11.00



SUMMARY OF WEIGHTS OF SORTS OF MATURE CROSSBRED EWE FLEECES

In sorting the fleeces from the mature crossbred ewes the weights of the various sorts from each fleece were not taken nor was individual fleece grade obtained. A total of 550 fleeces from the mature ewes of groups 4, 5, 6, and 7 were sorted. These fleeces yielded 63.51 percent of main sorts. The percent of main sorts was higher for the mature ewes than for the yearling ewes or rams.

	No. of fleeces	Percent of main sorts in fleeces	Average Weight in Pounds		
			Main sorts	Off sorts	Total
MATURE EWES:					
Groups 4, 5, 6, and 7	550	63.51	4.47	2.57	7.04

WEIGHT IN POUNDS OF MAIN SORTS AND OFF SORTS OF YEARLING CROSSBRED EWE AND RAM FLEECES

The following tables list the weights in pounds of the various main sorts and off sorts from the fleeces of the crossbred yearling ewes and rams.

The weights of the main sorts show a majority of the wool sorted was of Low 1/4 Blood grade for both yearling ewes and rams. This result indicates definite progress toward the production of the desired 48's quality wool in the breeding flock.

To facilitate the scouring operations the grading of the off sorts was not as refined as for the main sorts. For the off sorts the grades of 3/8 and 1/4 Blood were combined into one lot, the Low 1/4 Blood off sorts were maintained as one lot, and all off sorts grading Common and coarser were combined as one lot. By so doing only three grades are considered under the various off sorts classifications.

A total of 1,643.30 pounds of wool from the crossbred yearling ewes was sorted. This total yielded 1,013.48 pounds of main sorts. Of a total of 1,111.43 pounds of wool sorted from the yearling rams 652.74 pounds was separated into main sorts.

WEIGHTS OF MAIN SORTS AND OFF SORTS OF CROSSBRED YEARLING EWE FLEECES

Description of Sorts	Weight in pounds of sorts for breeding groups -				
	2 (lbs.)	3 (lbs.)	6 (lbs.)	7 (lbs.)	All groups (lbs.)
Main Sorts:					
Matchings					
3/8 Blood (58's-56's)	2.65	16.78	0.00	0.00	19.43
1/4 Blood (50's)	40.80	50.30	24.11	5.69	120.90
Low 1/4 Blood (48's-46's)	101.60	128.98	152.64	44.34	427.57
Common (44's)	43.81	62.94	94.23	85.83	286.82
Braid (40's)	6.73	15.84	26.90	36.13	85.60
Low Braid (36's)	2.58	9.16	26.87	34.56	73.16
Total	198.17	284.00	324.75	206.55	1,013.48
Off Sorts:					
Burry and Seedy					
3/8 - 1/4 Blood	0.00	9.68	2.97	0.00	12.66
Low 1/4 Blood	4.52	39.52	57.22	15.32	116.57
Common and coarser	40.36	6.39	30.46	30.19	107.41
Total	44.88	55.59	90.66	45.51	236.64
Stained					
3/8 - 1/4 Blood	4.88	3.69	0.14	0.00	8.72
Low 1/4 Blood	17.33	18.42	18.37	7.91	62.02
Common and coarser	3.52	7.41	16.10	18.96	45.99
Total	25.73	29.52	34.61	26.88	116.73
Tender					
3/8 - 1/4 Blood	10.07	3.10	3.29	0.00	16.46
Low 1/4 Blood	32.38	2.11	3.52	0.53	38.54
Common and coarser	3.08	2.31	6.94	0.00	12.33
Total	45.53	7.52	13.74	0.53	67.33
Belly					
3/8 - 1/4 Blood	5.93	5.92	1.94	0.52	14.31
Low 1/4 Blood	30.21	36.49	45.36	24.39	136.45
Common and coarser	2.05	2.02	7.26	9.62	20.96
Total	38.19	44.44	54.56	34.53	171.72
Paint	0.10	0.03	0.09	0.32	0.55
Tags	7.73	8.61	12.05	8.45	36.84
Total Off Sorts	162.17	145.71	205.72	116.22	629.82
GRAND TOTAL	360.35	429.71	530.47	322.77	1,643.30

WEIGHTS OF SORTS OF CROSSBRED YEARLING RAM FLEECES

Description of Sort	Weight in pounds of sorts for breeding groups -						All groups (lbs.)
	2 (lbs.)	3 (lbs.)	4 (lbs.)	5 (lbs.)	6 (lbs.)	7 (lbs.)	
Main Sorts:							
Matchings							
3/8 Blood (58's-56's)	0.00	0.30	0.00	0.10	0.00	0.00	0.40
1/4 Blood (50's)	25.71	40.19	11.12	23.73	6.04	1.76	108.55
Low 1/4 Blood (48's-46's)	83.62	86.80	50.26	35.88	83.05	46.43	386.05
Common (44's)	20.14	22.16	7.80	9.19	31.30	32.64	123.22
Braid (40's)	2.33	1.07	1.43	0.48	9.79	16.04	31.14
Low Braid 36's)	0.00	0.62	1.83	0.00	0.92	0.00	3.38
Total	131.80	151.13	72.44	69.39	131.11	96.87	652.74
Off Sorts:							
Burry and Seedy							
3/8 - 1/4 Blood	1.79	5.68	0.88	2.56	4.80	0.82	16.52
Low 1/4 Blood	16.26	21.44	11.84	6.64	15.66	12.93	84.77
Common and coarser	0.00	0.00	1.39	0.00	0.47	2.94	4.80
Total	18.05	27.11	14.11	9.20	20.92	16.68	106.10
Stained							
3/8 - 1/4 Blood	1.70	2.68	0.38	3.34	1.94	1.26	11.29
Low 1/4 Blood	26.54	24.69	12.12	10.46	20.42	11.70	105.94
Common and coarser	0.00	0.08	0.81	0.00	2.90	2.92	6.71
Total	28.24	27.46	13.91	13.79	25.25	15.88	123.94
Tender							
3/8 - 1/4 Blood	8.70	3.20	7.64	4.97	7.22	0.00	31.75
Low 1/4 Blood	22.88	13.92	3.18	7.10	24.30	0.74	72.13
Common and coarser	0.00	0.00	0.00	1.22	0.48	0.78	2.48
Total	31.59	17.12	10.82	13.30	32.00	1.52	106.35
Belly							
3/8 - 1/4 Blood	1.46	4.34	1.37	3.92	1.48	0.00	12.57
Low 1/4 Blood	20.29	21.27	9.15	6.99	17.54	14.78	90.02
Common and coarser	0.00	0.00	1.41	0.00	4.57	2.20	8.19
Total	21.75	25.61	11.92	10.91	23.60	16.98	110.77
Paint	0.03	0.05	0.06	0.03	0.44	0.41	1.02
Tags	0.62	1.68	3.18	0.69	2.56	1.68	10.41
Total Off Sorts	100.28	99.03	53.41	47.92	104.79	53.16	458.59
GRAND TOTAL	232.08	250.17	125.85	117.30	235.90	150.03	1,111.33

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PERCENTAGE OF MAIN AND OFF SORTS IN FLEECES
FROM YEARLING CROSSBRED EWES AND RAMS

The following tables summarize the percentages of the various main sorts and off sorts, for the several breeding groups of crossbred yearling ewes and rams. These tables contain some interesting information regarding the wool production of the different breeding groups.

The fleeces from the ewes of groups 2 and 3 were sorted into six main sorts ranging from 3/8 Blood to Low Braid while the fleeces from the ewes of groups 6 and 7 produced no wool of the 3/8 Blood sort. The highest percentages of main sorts occurred in the grade of Low 1/4 Blood for the ewes of groups 2, 3, and 6 and in the grade of Common for the ewes of group 7. Sorts grading Braid and Low Braid were produced in all groups. Fleeces that were hairy or with hairy breeches accounted for most of the wool grading Braid and Low Braid.

The burry and seedy off sorts totaled 14.40 percent of the wool sorted from the yearling ewes. Yearling ewes of groups 6 and 7 had a higher percentage of burry and seedy wool than the ewes of groups 2 and 3. This seems to be associated with the long staple, open tipped fleeces produced by the ewes of groups 6 and 7. The occurrence of burry and seedy wool is largely a matter of management. By destroying the cockle burrs on rather extensive areas of the winter range the production of this undesirable off sort would be materially reduced.

The percentage of the stained off sort was fairly constant for all groups of yearling ewes with an average of 7.10 percent of the wool sorted. In 1949 the sheep will be sheared about mid-April, and even though they are not crutched, the percentage of stained wool should be greater than was obtained in 1948 when the sheep were crutched during the latter part of March and sheared about June 20.

The percentages of tender wool for the yearling ewes have a peculiar distribution. The ewes of group 2 produced a total of 12.64 percent of tender wool. Group 3 ewes produced 1.75 percent tender wool, group 6, 2.59 percent, and group 7 only 0.16 percent of tender wool. The production of tender wools is a common problem throughout the southwest. It is assumed to be associated with faulty nutrition, particularly during the winter months. The cause of the high percentage of tender wool produced by the ewes of group 2, while the ewes of the other groups under the same conditions of management produced comparatively negligible percentages, is without definite explanation. Inasmuch as the condition is largely confined to the ewes of group 2 it appears, in this case, to be associated with the breeding of the ewes.

As in the case of the stained off sorts, the total percentages of the belly off sorts was very similar for all groups of ewes. The belly off sorts

for the yearling ewes amounted to 10.45 percent of the total wool sorted. The paint and tags off sorts were 0.03 percent and 2.24 percent, respectively, of the sorted wool from the yearling ewes.

The fleeces from the yearling rams were sorted into the same grade sorts as the yearling ewes. However, the percentages of the 3/8 Blood, Braid, and Low Braid main sorts were lower for the yearling rams than for the ewes. Since the rams are a more select group, with selection emphasizing the coarser, non-hairy fleeces, these differences seem easily explained. The highest percentage of main sorts occurred in the grade of Low 1/4 Blood for all groups of yearling rams. Of the wool sorted from the yearling rams 58.74 percent was main sorts with 34.74 percent being of Low 1/4 Blood grade.

Burly and seedy off sorts for the yearling rams totaled 9.55 percent of their sorted wool. This was 4.85 percent lower than the burly and seedy wool from the yearling ewes. The rams were maintained in feed lots during the winter months which accounts for part of this difference.

The percentages of stained wool produced by the various groups of rams were fairly constant. Stained wool accounted for 11.15 percent of the sorted wool from the rams and was 4.05 percent higher than the same sort from the yearling ewes. No doubt the amount of stained wool produced by the yearling rams can be considerably reduced by providing shed space and bedding for the rams during the winter feeding period.

As with the yearling ewes, the percentage of tender wool produced by the rams is cause for concern. The average percentage of tender wool for all yearling rams was 9.57 percent of the wool sorted. The rams of groups 2 and 6 produced over 13 percent tender wool. These groups were followed by group 5 with 11.33 percent, group 4, 8.60 percent, group 2, 6.84 percent, and group 7 with only 1.01 percent of tender wool. All the yearling rams were under the same conditions of feeding and management throughout the year. As with the yearling ewes, the production of tender wool by the rams appears to be associated with the breeding of the sheep rather than with environmental factors.

Percentages of the belly off sort wool was fairly constant for all groups of yearling rams. The average percentage of belly wool was 9.97 percent of the wool sorted from the yearling rams. Paint off sorts averaged 0.09 percent, and the tags averaged 0.94 percent of the wool sorted from the yearling rams.

PERCENTAGES OF SORTS OF CROSSBRED YEARLING EWE FLEECES

Description of Sorts	Percentages of sorts for breeding groups -				
	2 (%)	3 (%)	6 (%)	7 (%)	All groups (%)
Main Sorts:					
Matchings					
3/8 Blood (58's-56's)	0.74	3.90	0.00	0.00	1.18
1/4 Blood (50's)	11.32	11.70	4.54	1.76	7.36
Low 1/4 Blood (48's-46's)	28.20	30.02	28.78	13.74	26.02
Common (44's)	12.16	14.65	17.76	26.59	17.45
Braid (40's)	1.87	3.69	5.07	11.20	5.21
Low Braid (36's)	0.72	2.13	5.06	10.71	4.45
Total	55.00	66.09	61.22	63.99	61.67
Off Sorts:					
Burry and Seedy					
3/8 - 1/4 Blood	0.00	2.25	0.56	0.00	0.77
Low 1/4 Blood	1.25	9.20	10.79	4.75	7.09
Common and coarser	11.20	1.49	5.74	9.35	6.54
Total	12.46	12.94	17.09	14.10	14.40
Stained					
3/8 - 1/4 Blood	1.36	0.86	0.03	0.00	0.53
Low 1/4 Blood	4.81	4.29	3.46	2.45	3.77
Common and coarser	0.98	1.72	3.04	5.88	2.80
Total	7.14	6.87	6.52	8.33	7.10
Tender					
3/8 - 1/4 Blood	2.80	0.72	0.62	0.00	1.00
Low 1/4 Blood	8.99	0.49	0.66	0.16	2.34
Common and coarser	0.86	0.54	1.31	0.00	0.75
Total	12.64	1.75	2.59	0.16	4.10
Belly					
3/8 - 1/4 Blood	1.65	1.38	0.37	0.16	0.87
Low 1/4 Blood	8.38	8.49	8.55	7.56	8.30
Common and coarser	0.57	0.47	1.37	2.98	1.28
Total	10.60	10.34	10.29	10.70	10.45
Paint	0.03	0.01	0.02	0.10	0.03
Tags	2.14	2.00	2.27	2.62	2.24
Total Off Sorts	45.00	33.91	38.78	36.01	38.33
GRAND TOTAL	100.00	100.00	100.00	100.00	100.00

PERCENTAGES OF SORTS OF CROSSBRED YEARLING RAM FLEECES

Description of Sorts	Percentages of sorts for breeding groups -						
	2 (%)	3 (%)	4 (%)	5 (%)	6 (%)	7 (%)	All groups (%)
Main Sorts:							
Matchings							
3/8 Blood (58's-56's)	0.00	0.12	0.00	0.09	0.00	0.00	0.04
1/4 Blood (50's)	11.08	16.06	8.84	20.23	2.56	1.17	9.77
Low 1/4 Blood (48's-46's)	36.03	34.70	39.94	30.59	35.21	30.95	34.74
Common (44's)	8.68	8.86	6.20	7.83	13.27	21.76	11.09
Braid (40's)	1.00	0.43	1.13	0.41	4.15	10.69	2.80
Low Braid (36's)	0.00	0.25	1.46	0.00	0.39	0.00	0.30
Total	56.79	60.41	57.56	59.15	55.58	64.57	58.74
Off Sorts							
Burly and Seedy							
3/8 - 1/4 Blood	0.77	2.27	0.70	2.18	2.04	0.54	1.49
Low 1/4 Blood	7.01	8.57	9.41	5.66	6.64	8.62	7.63
Common and coarser	0.00	0.00	1.10	0.00	0.20	1.96	0.43
Total	7.78	10.84	11.21	7.84	8.88	11.12	9.55
Stained							
3/8 - 1/4 Blood	0.73	1.07	0.30	2.84	0.82	0.84	1.02
Low 1/4 Blood	11.43	9.87	9.64	8.92	8.66	7.80	9.53
Common and coarser	0.00	0.03	0.64	0.00	1.23	1.95	0.60
Total	12.17	10.98	10.58	11.76	10.71	10.58	11.15
Tender							
3/8 - 1/4 Blood	3.75	1.28	6.07	4.24	3.06	0.00	2.86
Low 1/4 Blood	9.86	5.56	2.53	6.06	10.30	0.50	6.49
Common and coarser	0.00	0.00	0.00	1.04	0.20	0.52	0.22
Total	13.61	6.84	8.60	11.33	13.57	1.01	9.57
Belly							
3/8 - 1/4 Blood	0.63	1.73	1.09	3.34	0.63	0.00	1.13
Low 1/4 Blood	8.74	8.50	7.27	5.96	7.44	9.85	8.10
Common and coarser	0.00	0.00	1.12	0.00	1.94	1.47	0.74
Total	9.37	10.24	9.48	9.30	10.00	11.32	9.97
Paint	0.01	0.02	0.05	0.02	0.18	0.28	0.09
Tags	0.27	0.67	2.52	0.59	1.08	1.12	0.94
Total Off Sorts	43.21	39.59	42.44	40.85	44.42	35.43	41.26
GRAND TOTAL	100.00	100.00	100.00	100.00	100.00	100.00	100.00

WEIGHTS AND PERCENTAGES OF MAIN SORTS AND OFF SORTS
OF MATURE CROSSBRED EWE FLEECES

The following table lists both the weights and the percentages of the main and off sorts of the fleeces of mature crossbred ewes. A total of 3,875 pounds of wool sheared from 550 mature ewes was sorted. Of this total 2,461 pounds or 63.51 percent was classed as main sorts. The percentage of main sorts was higher for the mature ewes than for either the yearling ewes or rams.

Fleeces from the mature ewes were sorted into seven main sorts ranging from 1/2 Blood through Low Braid. The majority of wool sorted was of the grades of 1/4 Blood and Low 1/4 Blood, with relatively small amounts in the finer grades of 1/2 and 3/8 Blood. Hairy fleeces and breeches again accounted for most of the wools classed as Braid or Low Braid.

The burry and seedy off sort amounted to 14.42 percent of the total weight of sorted wool, from the mature ewes. This figure is comparable to the value obtained from the same sort, from the crossbred yearling ewe fleeces. The yearling and mature ewes were under the same conditions of management.

Of the wool sorted 8.62 percent went into the stained off sorts, a slightly higher percentage than for the crossbred yearling ewes. Similarly, a higher percentage of wool from the mature ewes went into the tender off sorts than was obtained from the yearling ewes. Tender wool accounted for 5.83 percent of the sorted wool from the mature ewes.

For the mature ewes the belly off sort amounted to 5.60 percent of the sorted wool, 4.85 percent less than the same sort for the yearling ewes. Paint and tag off sorts amounted to 0.49 percent and 1.52 percent, respectively, of the sorted wool from the mature crossbred ewes.

WEIGHTS AND PERCENTAGES OF SORTS
FROM MATURE CROSSBRED EWE FLEECES

Description of Sorts	Weight (pounds)	Percent of Total
<u>Main Sorts</u>		
Matchings		
1/2 Blood (60's-62's)	40	1.03
3/8 Blood (58's-56's)	210	5.42
1/4 Blood (50's)	532	13.73
Low 1/4 Blood (48's-46's)	662	17.08
Common (44's)	374	9.65
Braid (40's)	270	6.97
Low Braid (36's)	373	9.63
<u>Total</u>	<u>2,461</u>	<u>63.51</u>
<u>Off Sorts</u>		
Burly and Seedy		
3/8 - 1/4 Blood	101	2.61
Low 1/4 Blood	356	9.19
Common and coarser	102	2.63
<u>Total</u>	<u>559</u>	<u>14.42</u>
Stained		
3/8 - 1/4 Blood	17	0.44
Low 1/4 Blood	277	7.15
Common and coarser	40	1.03
<u>Total</u>	<u>334</u>	<u>8.62</u>
Tender		
3/8 - 1/4 Blood	111	2.86
Low 1/4 Blood	94	2.43
Common and coarser	21	0.54
<u>Total</u>	<u>226</u>	<u>5.83</u>
Belly		
3/8 - 1/4 Blood	12	0.31
Low 1/4 Blood	165	4.26
Common and coarser	40	1.03
<u>Total</u>	<u>217</u>	<u>5.60</u>
Paint	19	0.49
Tags	59	1.52
Total Off Sorts	1,414	36.49
<u>GRAND TOTAL</u>	<u>3,875</u>	<u>100.00</u>

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SCOURING SUMMARY FOR MAIN SORTS AND OFF SORTS OF
CROSSBRED YEARLING EWE FLEECES¹

<u>Description of Sorts</u>	<u>Grease weight (lbs.)</u>	<u>Clean weight (lbs.)</u>	<u>Shrinkage (%)</u>	<u>Yield (%)</u>
Main Sorts: ²				
Matchings				
1/2 Blood (60's-62's)	none			
3/8 Blood (56's-58's)	21.3	11.9	44.1	55.9
1/4 Blood (50's)	105.0	58.6	44.2	55.8
Low 1/4 Blood (46's-48's)	456.0	255.3	44.0	56.0
Common (44's)	318.5	193.2	39.3	60.7
Braid (40's)	71.7	47.0	34.4	65.6
Low Braid (36's)	57.5	38.4	33.2	66.8
Off Sorts: ³				
Burry and Seedy				
3/8 and 1/4 Blood	17.4	9.8	43.7	56.3
Low 1/4 Blood	138.5	88.3	36.2	63.8
Common and Braid	71.7	49.5	31.0	69.0
Stained				
3/8 and 1/4 Blood	5.7	2.5	56.2	43.8
Low 1/4 Blood	63.7	29.3	54.0	46.0
Common and Braid	51.5	22.5	56.3	43.7
Tender				
3/8 and 1/4 Blood	24.8	12.4	50.0	50.0
Low 1/4 Blood	40.6	25.9	36.2	63.8
Common and Braid	11.4	6.4	43.9	56.1
Belly				
3/8 and 1/4 Blood	12.9	5.2	59.7	40.3
Low 1/4 Blood	136.3	69.6	48.9	51.1
Common and Braid	26.4	14.0	47.0	53.3
Paint	1.6	0.9	41.2	58.8
Tags	36.4	10.6	70.9	29.1
Totals and Averages	1668.9	951.3	43.0	57.0

¹Fleeces were sheared June 21-24, 1948, sorted in July 1948, and scoured at the Texas Agricultural Experiment Station on March 2-4, 1949.

²Scoured wool corrected to U. S. Customs Standard for Impurities.

³Scoured wool adjusted to 12 percent condition.

1. The first part of the document is a list of names and addresses, which are arranged in a table-like format. The names are listed in the first column, and the addresses are listed in the second column. The names are: John Doe, Jane Smith, and Mary White. The addresses are: 123 Main St, 456 Elm St, and 789 Oak St.

SCOURING SUMMARY FOR MAIN SORTS AND OFF SORTS OF
CROSSBRED YEARLING RAM FLEECES¹

<u>Description of Sorts</u>	<u>Grease weight (lbs.)</u>	<u>Clean weight (lbs.)</u>	<u>Shrinkage (%)</u>	<u>Yield (%)</u>
Main Sorts: ²				
Matchings				
1/2 Blood (60's-62's)	none			
3/8 Blood (56's-58's)	none			
1/4 Blood (50's)	104.1	57.7	44.6	55.4
Low 1/4 Blood (46's-48's)	408.5	233.2	42.9	57.1
Common (44's)	130.8	81.8	37.5	62.5
Braid (40's)	31.3	19.9	36.4	63.6
Low Braid (36's)	none			
Off Sorts: ³				
Burry and Seedy				
3/8 and 1/4 Blood	14.7	8.1	44.9	55.1
Low 1/4 Blood	91.1	56.4	38.1	61.9
Common and Braid	5.8	4.1	29.3	70.7
Stained				
3/8 and 1/4 Blood	16.2	8.1	50.0	50.0
Low 1/4 Blood	109.0	55.8	48.8	51.2
Common and Braid	7.0	4.0	42.9	57.1
Tender				
3/8 and 1/4 Blood	28.3	16.0	43.5	56.5
Low 1/4 Blood	76.7	43.9	42.8	57.2
Common and Braid	2.5	1.5	40.0	60.0
Belly				
3/8 and 1/4 Blood	17.7	8.5	52.0	48.0
Low 1/4 Blood	90.0	42.8	52.4	47.6
Common and Braid	8.2	4.5	45.1	54.9
Paint	(
Tags	(13.0	5.4	58.5	41.5
Totals and Averages	1154.9	651.7	43.6	56.4

¹Fleeces were sheared June 21-24, 1948, sorted in July 1948, and scoured at the Texas Agricultural Experiment Station on March 14-16, 1949.

²Scoured wool corrected to U. S. Customs Standard for Impurities.

³Scoured wool adjusted to 12 percent condition.

TABLE I				
Summary of the results of the experiments on the effect of the concentration of the solution on the rate of the reaction				
Concentration of the solution (M)	Time (min)	Volume of gas evolved (ml)	Rate of reaction (ml/min)	Remarks
0.1	10	10	1.0	
0.2	10	20	2.0	
0.3	10	30	3.0	
0.4	10	40	4.0	
0.5	10	50	5.0	
0.6	10	60	6.0	
0.7	10	70	7.0	
0.8	10	80	8.0	
0.9	10	90	9.0	
1.0	10	100	10.0	
0.1	20	20	1.0	
0.2	20	40	2.0	
0.3	20	60	3.0	
0.4	20	80	4.0	
0.5	20	100	5.0	
0.6	20	120	6.0	
0.7	20	140	7.0	
0.8	20	160	8.0	
0.9	20	180	9.0	
1.0	20	200	10.0	
0.1	30	30	1.0	
0.2	30	60	2.0	
0.3	30	90	3.0	
0.4	30	120	4.0	
0.5	30	150	5.0	
0.6	30	180	6.0	
0.7	30	210	7.0	
0.8	30	240	8.0	
0.9	30	270	9.0	
1.0	30	300	10.0	
0.1	40	40	1.0	
0.2	40	80	2.0	
0.3	40	120	3.0	
0.4	40	160	4.0	
0.5	40	200	5.0	
0.6	40	240	6.0	
0.7	40	280	7.0	
0.8	40	320	8.0	
0.9	40	360	9.0	
1.0	40	400	10.0	
0.1	50	50	1.0	
0.2	50	100	2.0	
0.3	50	150	3.0	
0.4	50	200	4.0	
0.5	50	250	5.0	
0.6	50	300	6.0	
0.7	50	350	7.0	
0.8	50	400	8.0	
0.9	50	450	9.0	
1.0	50	500	10.0	

TABLE II

Summary of the results of the experiments on the effect of the temperature on the rate of the reaction

Temperature (°C)	Time (min)	Volume of gas evolved (ml)	Rate of reaction (ml/min)	Remarks
10	10	10	1.0	
20	10	20	2.0	
30	10	30	3.0	
40	10	40	4.0	
50	10	50	5.0	
60	10	60	6.0	
70	10	70	7.0	
80	10	80	8.0	
90	10	90	9.0	
100	10	100	10.0	

SCOURING SUMMARY FOR MAIN SORTS AND OFF SORTS OF
CROSSBRED MATURE EWE FLEECES¹

<u>Description of Sorts</u>	<u>Grease weight (lbs.)</u>	<u>Clean weight (lbs.)</u>	<u>Shrinkage (%)</u>	<u>Yield (%)</u>
Main Sorts: ²				
Matchings				
1/2 Blood (60's-62's)	37.4	17.1	54.3	45.7
3/8 Blood (56's-58's)	206.8	108.0	47.8	52.2
1/4 Blood (50's)	525.3	292.1	44.4	55.6
Low 1/4 Blood (46's-48's)	656.0	384.6	41.4	58.6
Common (44's)	369.8	231.7	37.3	62.7
Braid (40's)	268.9	172.4	35.9	64.1
Low Braid (36's)	360.8	229.4	36.4	63.6
Off Sorts: ³				
Burry and Seedy				
3/8 and 1/4 Blood	69.2	38.2	44.8	55.2
Low 1/4 Blood	349.4	218.0	37.6	62.4
Common and Braid	97.8	64.5	34.0	66.0
Stained				
3/8 and 1/4 Blood	15.3	6.5	57.5	42.5
Low 1/4 Blood	272.9	134.2	50.8	49.2
Common and Braid	36.1	16.8	53.4	46.6
Tender				
3/8 and 1/4 Blood	101.1	51.8	48.8	51.2
Low 1/4 Blood	89.7	53.4	40.5	59.5
Common and Braid	19.4	12.3	36.6	63.4
Belly				
3/8 and 1/4 Blood	35.7	19.9	44.3	55.7
Low 1/4 Blood	160.4	81.9	48.9	51.1
Common and Braid	36.7	20.7	43.6	56.4
Paint	17.0	9.6	43.5	56.5
Tags	54.8	19.6	64.2	35.8
Totals and Averages	3780.5	2182.7	42.3	57.7

¹Fleeces were sheared June 21-24, 1948, sorted in July 1948, and scoured at the Texas Agricultural Experiment Station on March 4-14, 1949.

²Scoured wool corrected to U. S. Customs Standard for Impurities.

³Scoured wool adjusted to 12 percent condition.

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DISPOSITION OF 1947 WOOL CLIP

<u>Production</u>	<u>Fleece wool (lbs.)</u>	<u>Crutchings and tags (lbs.)</u>
1947 Wool Clip	8348	709
<u>Sales</u>		
Individual Indians	773	62
Indian Service Schools	300	
Indian Traders	3632	
Commission Company	_____	<u>647</u>
TOTALS	4705	709

In addition to the above sales a total of 172 pounds of scoured wool was sold to individual Indians and traders. Approximately 3300 pounds of fleece wool from the 1947 clip was on hand at the end of the year.

SALES OF RAMS DURING 1948

A total of 107 crossbred breeding rams were sold by the laboratory during 1948 which represents an increase of 72.6 percent compared to the number sold in 1947. Fifty-eight individual Navajo Indians purchased 99 of the rams and the remaining 8 head were purchased by the Navajo Tribal Ram Pastures Project for resale or rental to Indians. Four of the rams were two years of age, and the other 103 were yearlings, produced in breeding groups numbered 2, 3, 4, 5, 6, and 7. Data on the body and fleece characteristics of the yearling rams are given on pages 36 and 39.

Following is a summary of the ram sales by districts of the Navajo Reservation:

<u>Number of rams sold</u>	<u>Number of individual buyers</u>	<u>District number</u>
10*	1	1
15	10	3
1	1	7
1	1	9
23	14	11
13	9	12
22	14	16
2	2	18

*Number includes 8 rams purchased by the Tribal Ram Pastures Project.

In addition to the sales tabulated above, 19 yearling rams were sold to Navajo Indians living in the vicinity of Ramah, New Mexico. Indians in this locality are under the jurisdiction of the United Pueblos Agency, Albuquerque, New Mexico.

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WOOL SCHOOL HELD AT LABORATORY

A Wool School held at the laboratory March 29 to April 1, 1948, was attended by 30 Indian Service personnel, including the extension agents from the Navajo, Hopi, Consolidated Ute, and Jicarilla Indian Agencies; and most of the District Supervisors, Farm Agents, and other personnel connected with livestock and range work on the Navajo Reservation.

Navajo Service personnel in charge of extension and livestock work on the reservation assisted laboratory personnel in conducting the program. The four-day program included the following main topics:

1. Outlook for sheep and wool in 1948.
2. Present status of the Navajo sheep industry.
3. Properties of wool which determine its market value.
4. Progress of research work of the laboratory and its practical application in the improvement of Navajo-owned flocks.

Lectures and discussions were supplemented with demonstrations on the determination of grade and shrinkage of wool, and tying, grading, and bagging wool for market. Another feature was the judging of several classes of breeding rams, yearling rams, and yearling ewes, in which everyone participated.

Guest speakers at the Wool School, and topics which they discussed were as follows:

1. "Sheep Parasites and Methods of Control", by Dr. Roberts, Zoological Division Bureau of Animal Industry.
2. "Predatory Animal Control", by Mr. Lewis Laney, District Agent, Fish and Wildlife Service.
3. "The 1948 Wool Purchase Program As It Will Apply to Navajo Grown Wools", was discussed by Mr. James Good, appraiser for the Commodity Credit Corporation, and Mr. Reed Warnick, representing Merriam and Wilkins Company of Denver, Colorado.
4. "Trends of the Sheep Industry and Problems Affecting the Future of the Industry", by Mr. Floyd W. Lee, President of the New Mexico Wool Growers Association.

The primary purpose of the Wool School was to acquaint Indian Service personnel with the organization and objectives of the laboratory, the accomplishments of the work to date and its practical application in improving sheep and wool to meet the requirements of the Indians.

